New Scientist

WEEKLY 27 November 2021

FOCUS ON
COVID
Evidence confirms
Wuhan market origin

*What we know so far
about the AY.4.2 variant*

THE DIRTIEST INDUSTRY
Can shipping clean up its act?

SURVIVAL OF THE KINDEST

A new theory on how *Homo sapiens* conquered the planet

COLD BLACK LAVA
Secrets of the world's weirdest volcano

PLUS QUANTUM TRANSPARENCY / **HOW TO SPOT CERES** / **TREATING MILK ALLERGIES** / PLASTIC MADE FROM DNA

No3362 £6.95 CAN$9.99

SUSTAIN.
ABILITY.

JUPITER GLOBAL SUSTAINABLE EQUITIES FUND

Transformational businesses, with the right mindset and imagination, can lead the transition to a more sustainable world economy. With over three decades of combined ESG investment experience, our global sustainable equities team believes that companies that balance the interests of the planet, people and profit are the most sustainable in the long term. We have dedicated our careers to identifying businesses with a demonstrable commitment to supporting this transition to a brighter future. We call this human advantage 'the value of active minds'. Visit **jupiteram.com**

As with all investing, your capital is at risk.

JUPITER
ASSET MANAGEMENT

This advert is for informational purposes only and is not investment advice. We recommend you discuss any investment decisions with a financial adviser, particularly if you are unsure whether an investment is suitable. The Key Investor Information Document, Supplementary Information Document and Scheme Particulars are available from Jupiter on request. Jupiter Unit Trust Managers Limited, registered address: The Zig Zag Building, 70 Victoria Street, London SW1E 6SQ is authorised and regulated by the Financial Conduct Authority. JAM001957-002-0421

This week's issue

On the cover

38 Survival of the kindest
A new theory on how *Homo sapiens* conquered the planet

42 Cold black lava
Secrets of the world's weirdest volcano

Vol 252 No 3362
Cover image: Jason Lyon

FOCUS ON COVID
18 Evidence confirms Wuhan market origin
8 What we know so far about the AY.4.2 variant

45 The dirtiest industry
Can shipping clean up its act?

20 Quantum transparency
51 How to spot Ceres
13 Treating milk allergies
15 Plastic made from DNA

38 Features

> **"Our emotional neediness may have been our trump card during climate changes"**

News

11 Salmon hybrids
Two species are mixing in the Pacific Northwest

15 Anti-satellite weapons
Will Russia's test prompt more regulation or an arms race?

20 Quantum phenomenon
More than three decades since it was predicted, Pauli blocking has finally been observed

Views

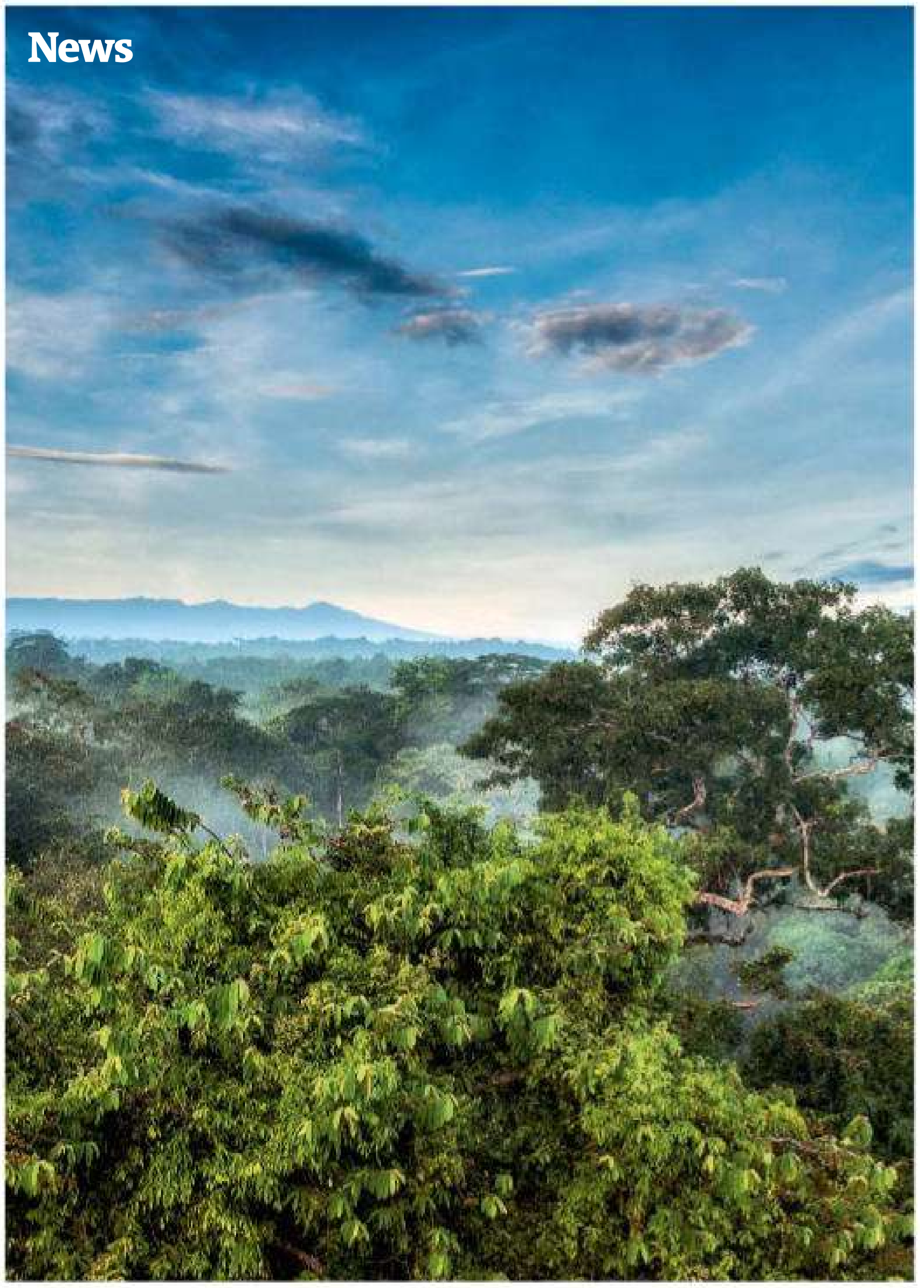
25 Comment
Michael Brooks on improving the perception of maths

26 The columnist
Tech companies don't get sci-fi, says Annalee Newitz

28 Letters
Half a century is too long to wait for net zero

30 Aperture
Scenes from historic expeditions around the world

34 Culture
Break the Internet is a detailed look at online influencers



MINDEN PICTURES/ALAMY

9 Warming tropics How rising temperatures are affecting vital forests

Features

38 The last human
Of all the types of humans that existed, why are we the only ones left?

42 The weirdest volcano
A Tanzanian mountain could hold clues to the secrets of Earth's mantle

45 Green shipping
What might it take to clean up this incredibly polluting industry?

The back pages

51 Stargazing at home
How to spot Ceres

53 Puzzles
Try our crossword, quick quiz and logic puzzle

54 *Almost* the last word
Can bullets fired into the air injure us when coming down?

55 Tom Gauld for *New Scientist*
A cartoonist's take on the world

56 Feedback
The future, now, via planting laurels: the week in weird

Elsewhere on New Scientist

Hybrid event

New Scientist Live 2022, Manchester

The mind-blowing festival of ideas is back, this time in a new venue and combining the best of live and virtual experiences. We will welcome 40 speakers and 30 exhibitors in person for amazing talks and hands-on demonstrations. Join us from 29 to 31 January 2022 at Manchester Central, UK. Find out what's happening online.

live.newscientist.com

Online

Covid-19 daily briefing

Stay on top of all the most crucial developments in the pandemic with our briefing, updated at 12pm GMT every weekday. As well as a round-up of the latest coronavirus news, there are links to exclusive interviews and features.

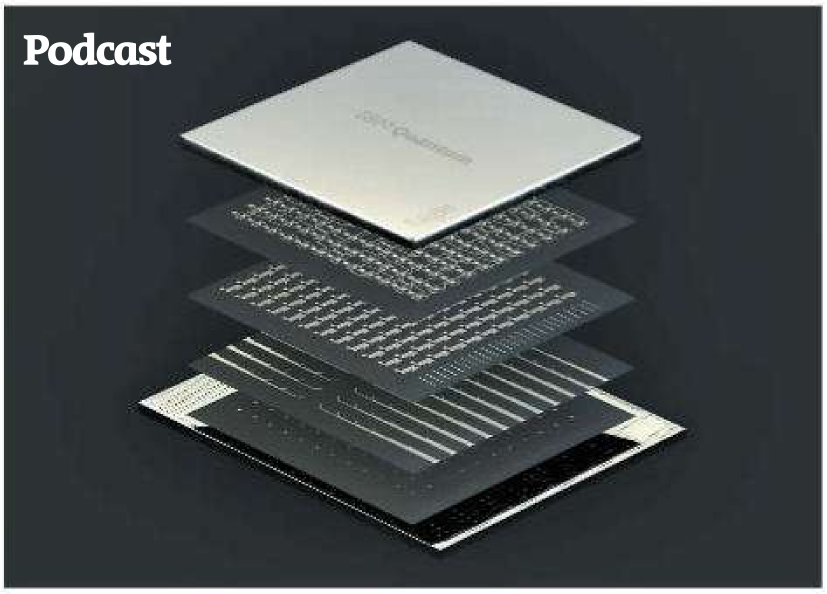
newscientist.com/coronavirus-latest

Podcast

Weekly

The race to build a useful quantum computer continues, with IBM setting a new benchmark for processing power last week. The team asks what it means. Plus: Russia's anti-satellite weapon test; science YouTuber Philipp Dettmer on his new book *Immune: A journey into the mysterious system that keeps you alive*; and an AI drug detective that has been trained to help keep "legal highs" off the market.

newscientist.com/nspod



IBM

More qubits IBM's Eagle is the biggest quantum computer of its kind

ZSL WHIPSNADE ZOO

DNA extraction This rhino's cells could help conservation efforts

Video

White rhino DNA

Researchers at ZSL Whipsnade Zoo in the UK recently had to put down their elderly white rhino, Clara. As they did so, they extracted some of her DNA and cells for storage in a biobank. Watch the researchers talk about how this could help with research into ageing and how best to keep conserving rhinos. Don't forget to subscribe to our channel for more great videos.

youtube.com/newscientist

Newsletter

Launchpad

Get reporter Leah Crane's wonderful newsletter on all things space delivered free to your inbox each week. In the latest issue, she looks at the fallout from Russia's recent anti-satellite weapon test and how the debris it created endangered astronauts board the International Space Station.

newscientist.com/launchpad

Newsletter

> **"The test created more than 1500 shards of satellite that were large enough to track"**

Calendar 2022

Our A3 wall calendar showcases all 12 of the shortlisted entries from *New Scientist*'s Photography Awards 2021. It features all UK bank holidays and key scientific dates – perfect for helping to keep you organised in the new year.

shop.newscientist.com/calendar

In the woods, not every conversation starts with a Tweet...

Technology innovation is helping save Earth's natural habitats and ecosystems. Bio-acoustic monitoring, combined with AI and cloud technology, is allowing conservationists to better understand and protect endangered species in real-time, like never before.

The Mammal Society, Rainforest Connection and Huawei UK are teaming up to help conserve the indigenous and rare red squirrel species in the UK.

Get involved with
The Mammal Society
www.mammal.org.uk

Photography by Dani Connor | @DaniConnorWild

Mammal Society
RAINFOREST CONNECTION
HUAWEI
TECH 4ALL

Learn more about
Huawei TECH4ALL

Unlock investing by unlocking your phone.

Download the simple investing app at *freetrade.io/free* and get started with a free share worth up to **£200**.*

British Bank Awards Best online trading platform 2019-2021

Capital at risk. The value of your investments can go down as well as up.

*Terms apply. Offer available to new UK-resident customers aged 18+ who fund their account with a minimum of £1.

Freetrade

Our true nature

The softer side of humans could have given us the edge – let's celebrate that

IT IS sobering to think that if the Neanderthals had continued for 2000 more generations, they would still be sharing the planet with us today. Our other close relatives, the mysterious Denisovans, came even closer to surviving to modern times, and would have needed just 750 more generations of their lineage.

Instead, we *Homo sapiens* find ourselves alone, the sole survivors out of the seven or more types of human that we once shared a planet with. It is easy to assume that we killed the others off, but the most likely explanation for their demise is that dramatic swings in the climate left these other humans – who evidence suggests lived in small, isolated groups – vulnerable to dying out.

Another common assumption is that our early *Homo sapiens* ancestors led lives that were "nasty, brutish and short" in the words of English philosopher Thomas Hobbes who, in his 1651 book *Leviathan*, reflected rather pessimistically on the nature of humans.

But if the latest archaeological and genetic research is to be believed, we shouldn't be so hard on ourselves. In fact, our soft skills – compassion, tolerance and the desire to make connections with others – may have been the secret to our survival through those climate swings when all the other types of human died out.

> "It wasn't survival of the brutish, but survival of the compassionate and sociable"

The social networks formed as a result of our emotional nature were a vital insurance policy for tougher times, allowing our early *Homo sapiens* ancestors to share not only food and resources but ideas. This, in turn, left us better able to adapt to the vagaries of the climate, as we discuss in our cover story on page 38.

It wasn't survival of the brutish, but survival of the compassionate and sociable.

Now, the million dollar question is whether these emotional skills will get us out of hot water as the climate on our planet changes yet again. Will they be enough to ensure that in 2000 more generations we haven't met the same fate as all the other types of human? ▮

PUBLISHING & COMMERCIAL

Commercial and events director Adrian Newton
Display advertising
Tel +44 (0)203 615 6456 **Email** displayads@newscientist.com
Sales director Justin Viljoen
Recruitment advertising
Tel +44 (0)203 615 6458 **Email** nssales@newscientist.com
Recruitment sales manager Viren Vadgama
Key account manager Deepak Wagjiani
New Scientist Events
Tel +44 (0)203 615 6554 **Email** live@newscientist.com
Sales director Jacqui McCarron
Event manager Henry Gomm
Marketing manager Emiley Partington
Events and projects executive Georgia Peart
New Scientist Discovery Tours
Director Kevin Currie
Marketing & Data
Marketing director Jo Adams
Head of campaign marketing James Nicholson
Head of customer experience Emma Robinson
Head of audience data Rachael Dunderdale
Digital marketing manager Craig Walker
Digital marketing manager – Academy Kathy Coleman
Customer experience marketing manager Esha Bhabuta
Marketing assistant Charlotte Weeks
Business intelligence analyst Michael Prosser
Digital Products
Digital product development director Laurence Taylor
Head of learning experience Finola Lang
Technology
Chief operations officer International
Debora Brooksbank-Taylor
Technology director Tom McQuillan
Maria Moreno Garrido, Dan Pudsey, Amardeep Sian,
Ben Townsend, Piotr Walków

NewScientist

Chief executive Nina Wright
Executive assistant Lorraine Lodge
Finance & operations
Chief financial officer Amee Dixon
Financial controller Taryn Skorjenko
Commercial finance manager Charlotte Thabit
Facilities manager Ricci Welch
Human resources
Human resources director Shirley Spencer
HR business partner Katy Le Poidevin

CONTACT US

newscientist.com/contact
General & media enquiries
UK **Tel**+44 (0)203 615 6500
Northcliffe House, 2 Derry Street, London, W8 5TT
Australia 58 Gipps Street, Collingwood, Victoria 3066
US PO Box 80247, Portland, OR 97280
UK Newsstand
Marketforce UK Ltd **Tel** +44 (0)33 0390 6555
Syndication
Tribune Content Agency **Tel** +44 (0)20 7588 7588
Email tca-articlesales@tribpub.com
Subscriptions
newscientist.com/subscription
One year print subscription (51 issues) UK £198
Tel +44 (0)330 333 9470
Email subscriptions@newscientist.com
Post New Scientist, Rockwood House, Perrymount Road,
Haywards Heath, West Sussex RH16 3DH

© 2021 New Scientist Ltd, England. New Scientist is published weekly by New Scientist Ltd. ISSN 0262 4079. New Scientist (Online) ISSN 2059 5387. Registered at the Post Office as a newspaper and printed in England by Precision Colour Printing Ltd

EDITORIAL

Editor Emily Wilson
Executive editor Richard Webb
Creative director Craig Mackie
News
News editor Penny Sarchet
Editors Jacob Aron, Chelsea Whyte
Reporters (UK) Jessica Hamzelou, Michael Le Page,
Matthew Sparkes, Adam Vaughan, Clare Wilson
(US) Leah Crane, (Aus) Alice Klein
Trainee Jason Arunn Murugesu
Interns Chen Ly, Carissa Wong
Digital
Digital editor Conrad Quilty-Harper
Podcast editor Rowan Hooper
Web team Emily Bates, Matt Hambly,
Alexander McNamara, David Stock, Sam Wong
Features
Head of features Catherine de Lange
and Tiffany O'Callaghan
Editors Abigail Beall, Daniel Cossins, Anna Demming,
Kate Douglas, Alison George, Joshua Howgego
Feature writer Graham Lawton
Culture and Community
Comment and culture editor Timothy Revell
Liz Else
Subeditors
Chief subeditor Eleanor Parsons
Bethan Ackerley, Tom Campbell,
Chris Simms, Jon White
Design
Art editor Julia Lee
Joe Hetzel, Ryan Wills
Picture desk
Picture editor Helen Benians
Tim Boddy
Production
Production manager Joanne Keogh
Robin Burton

New Ranger Stormtrak. With up to 500Nm
of torque from a Bi-turbo engine.

THE PICKUP

ford.co.uk

Ancient hominin Bones reveal how *Australopithecus sediba* walked **p9**

UK visa scheme Fast-track route for prize-winning scientists flops **p12**

Coma predictions Anaesthesia gives clues as to who will wake up **p14**

Strobe weapons Non-lethal devices used in European border dispute **p16**

AI editor Artificial intelligence can help improve Wikipedia **p18**

ASHLEY COOPER/GETTY IMAGES

A turbine at an offshore wind farm near Cumbria, UK

Renewables

Bulb collapses in UK

The fall of the green energy firm isn't a good look, but is unlikely to be bad news for new wind and solar power, reports **Adam Vaughan**

GREEN energy pioneer Bulb went from start-up to the UK's seventh biggest energy supplier in six years by pricing electricity from wind and solar power at aggressively low levels. On 22 November, it effectively collapsed in the UK amid the ongoing shock of soaring gas prices, which have also fed into higher wholesale electricity costs.

The large size of the company, which also supplied what it called carbon-neutral gas, means that its 1.7 million UK customers won't immediately be switched to a rival supplier, but the firm will instead continue under a special administrator appointed by the country's energy regulator, Ofgem. Bulb is the biggest UK energy supplier to fail in 19 years.

On the face of it, this would seem to be a blow to the UK government's new ambition to fully decarbonise its electricity grid by 2035. However, the way the nation's energy market works means Bulb's fate is unlikely to deter the investors who are putting billions of pounds into gargantuan new wind farms off the country's coast.

"I don't think the Bulb collapse will have a big bearing on renewables investment," says Richard Howard at analyst Aurora Energy Research.

In the UK, the "vast majority" of investment in new wind and solar projects currently hinges on a financial model of winning contracts from the government for a guaranteed price for the power those projects will generate, so-called Contracts for Difference (CfDs), notes Howard.

The other route to a final investment decision on new renewables schemes is by a big energy user such as a factory owner signing a deal for long-term, fixed-price supply (a power purchase agreement, or PPA) with the renewables developer.

> "It's obviously bad news when any major renewables company goes out of business"

The way Bulb bought its green energy for households has little effect on either route. Less than 5 per cent of its electricity was bought through a PPA last year. The rest was obtained on the wholesale market and then "greened" by buying a matching amount of certificates sold by companies that own wind and solar farms. Those certificates in effect verify the electricity supplied as renewable.

The money that wind and solar farms generated through those certificates was only a "nice bonus" on top of revenue from the CfDs, says Robert Buckley at analyst Cornwall Insight.

And although Bulb was a big buyer of the certificates, it was no longer the biggest after rivals, including the "big six" firm E.ON, began emulating its model and started supplying customers with fully renewable electricity.

That imitation was just one sign that Bulb's approach of marketing itself on a single, affordable green energy tariff was "very influential", says Buckley. This means that when its 1.7 million customers are eventually switched by Ofgem to a rival supplier or suppliers, there is a good chance that the firm or firms involved will also be buying certificates for electricity from renewable sources.

It is nonetheless a bad look for such a high-profile green energy firm to fail. "I think it's obviously bad news when any major renewables company goes out of business," says Andrew Sissons at Nesta, a UK-based sustainable innovation charity.

However, Sissons says Bulb's troubles don't change the direction of travel. "In the longer term, with gas being prohibitively expensive, it does mean it's pretty obvious the answer is more renewables and more heat pumps, less gas boilers." ▮

Coronavirus

New variant gains ground

An offshoot of the delta coronavirus variant, known as AY.4.2, appears to be more transmissible, but not more dangerous, says **Michael Le Page**

AFTER a period of relative calm in terms of the coronavirus's evolution, further notable variants are now emerging. An offshoot of the delta variant, known as AY.4.2, appears to be slightly more infectious than the original delta, and could slowly replace it. Several other new variants are being monitored, including one that seems to have evolved undetected in Central Africa before spreading to Europe and beyond.

None of these emerging variants appear to be hugely more infectious or better at dodging immunity than delta, so aren't expected to trigger major waves of cases around the world. But the bad news is that it may be only a matter of time before such a variant evolves.

"Something with delta-like transmissibility, but which escapes immunity better, is entirely possible, and in fact it may even be inevitable eventually," says Tom Peacock at Imperial College London.

The SARS-CoV-2 coronavirus has been constantly mutating since jumping to people from other animals, but most mutants die out. Only a few new variants have a significant advantage over other competing ones. The alpha variant was around 50 per cent more transmissible than older variants, and caused a wave of new cases as it spread worldwide early this year. Then came delta, which was around 50 per cent more transmissible than alpha, and triggered yet another global surge in cases.

Delta has been outcompeting other variants in country after country, driving most of them to extinction. The dominance of delta temporarily slowed down the evolution of dangerous new variants by reducing the diversity of the virus – with less genetic diversity, the virus has less opportunity to evolve. But delta itself is now spawning new variants and diversifying.

BELINDA JIAO/SOPA IMAGES/LIGHTROCKET VIA GETTY IMAGES

Crowds at a Christmas market in Covent Garden, London, on 20 November

One of the new variants is AY.4.2. It has been designated a "variant under investigation" by the UK Health Security Agency (UKHSA), which is monitoring it, but hasn't yet been named a "variant of interest" by the World Health Organization, and so hasn't been given a name from the Greek alphabet.

AY.4.2 has a couple of extra mutations in the outer spike protein of the virus. The effect of these mutations isn't clear, but in the UK it has been slowly gaining ground and accounted for 15 per cent of all cases at the beginning of November. It appears to be slightly more infectious than delta.

Fortunately, AY.4.2 appears to be no better at dodging immunity than the original delta. "The vaccines work against all the variants we have seen emerge so far," says Meaghan Kall at UKHSA. "There is always the potential for that to change, though."

AY.4.2 doesn't appear to cause more severe disease, either. In fact, one study in the UK suggests it is slightly less likely to cause symptoms. But more studies are needed to confirm this, say some virologists. "This may likely turn out to have been a 'false positive' finding," tweeted Francois Balloux at University College London.

15%

The AY.4.2 variant's share of UK covid-19 cases in November

The UK may be the first to notice an increase in cases linked to AY.4.2 because its virus surveillance is more comprehensive than those of other countries, says Peacock. The variant is likely to be gaining ground in many other countries too, spawning yet more variants along the way, he says.

In fact, an offshoot called AY.4.2.1, with an extra spike mutation, appears to be spreading a bit faster than AY.4.2 in England, but it isn't possible to be sure of this so early on. "I wouldn't say anything on the horizon right now is very concerning," says Kall. "The reason that AY.4.2 is being very closely watched is that it may not take very much for one of these sublineages to gain mutations that do make it worse."

There is also concern about another new variant, called B.1.640, which Peacock helped identify in October. It was first detected in the Republic of the Congo. "This is the first [non-delta variant] we've seen growing in a country that has a background of delta," says Peacock.

What's striking about B.1.640 is that it isn't closely related to any other variants and already has a lot of genetic diversity, says Peacock. This suggests it has been circulating undetected for quite some time.

Its properties haven't yet been studied, but it has a lot of the same mutations as the C.1.2 variant first detected in South Africa, which is very good at dodging immunity, says Peacock. C.1.2 is still around but isn't gaining ground versus delta.

B.1.640 has now been detected in several European countries and Canada, but this apparently rapid spread might be due to a superspreader event at a school in France rather than any inherent advantage over other variants, says Peacock. It is too early still to tell if it can compete against the delta lineages.

"Pre-delta, this might have been a beast. Post-delta, I don't really know..." Balloux tweeted. ▮

Climate change

Tropical trees store less carbon during warmer years

Michael Marshall

TREES in tropical forests grow more slowly in years when the nights are warmer than average or dry-season days are unusually hot, according to a 21-year study. This suggests such forests will grow less as the world warms due to climate change – potentially taking up less carbon dioxide from the air and exacerbating warming.

"For the first time, we have a window on what a whole tropical forest is doing," says Deborah Clark at the University of Missouri-St Louis. "It is very scary."

Tropical forests contain an enormous amount of carbon, because the trees take in CO_2 from the air and use it to grow. Droughts, which are becoming more severe due to climate change, may harm the forests and release some of the stored carbon.

For over two decades, Clark and her husband David Clark, also at the University of Missouri-St Louis, lived at La Selva Biological Station in Costa Rica. From 1997 to 2018, they took detailed measurements of the surrounding tropical forest, tracking how much new wood was produced and the amount of leaves and other material that fell as litter.

The pair, with Steven Oberbauer at Florida International University, discovered that wood production fell in years with warmer nights – something previous studies had already suggested. The team also found that the trees produced less wood in years when temperatures in the dry season exceeded 28°C more often than usual (*JGR Biogeosciences*, doi.org/g6st).

While this hadn't previously been shown, Deborah Clark says it was expected because photosynthesis dramatically slows above this temperature.

The study adds to growing evidence of climate impacts on tropical forests, says Iain Hartley at the University of Exeter in the UK. "It looks like, as you warm the climate, you stress the plants and you reduce productivity. If you link that to drought as well, these ecosystems that have been helping us in the fight against climate change are going to have less ability to do that in the future."

Tree canopy at La Selva Biological Station in Costa Rica

ADRIAN HEPWORTH/ALAMY

He and his colleagues have studied another natural store of carbon, the soil. There is evidence that warmer temperatures will cause soils to release more greenhouse gas, as the heat activates microorganisms that decompose organic matter.

Hartley's team compared more than 9000 soil samples and found that, for the same temperature rise, coarse-grained soils lost more than three times as much carbon as fine-grained soils (*Nature Communications*, doi.org/g6sv).

Soils in the tropics are mostly very fine-grained, says Hartley, so they ought to be relatively resilient to warming. Soils in temperate and polar regions are coarser and more likely to release their carbon.

To find out even more about how tropical forests will respond, Hartley is collaborating on a new project called AmazonFACE. This involves pumping controlled volumes of CO_2 into patches of the Amazon rainforest to see how plants fare in simulated conditions of the year 2050. ▮

Human evolution

Hominin had curved spine that helped with upright walking

SPINAL bones of an extinct human relative have been found in lumps of rock blasted out of a South African cave and used to reconstruct one of the most complete back fossils of any hominin.

The spine was curved, suggesting that *Australopithecus sediba* spent a lot of time walking on two legs.

***A. sediba* was first described in 2010 by Lee Berger at the University of the Witwatersrand in Johannesburg, South Africa, and his team. They described two partially preserved individuals: a male child called Karabo and an adult female. Both were found in the Malapa cave system and lived about 2 million years ago.**

Malapa was first excavated by miners around a century ago, and some of the first *A. sediba* bones were found in chunks of rock that had been blasted from the cave with dynamite.

The miners used some of the blocks to build a road. For the past decade, Berger's colleagues have been chipping away at these blocks. One has now yielded four vertebrae from the lower back of the female, plus a bone called the sacrum that links the spine to the pelvis. The team has named the female Issa, which means "protector" in Swahili.

The new bones mean that most of Issa's lower back has now been excavated. After fitting the vertebrae together, the team concluded that her spine was curved so that, when viewed from the side, it forms a gentle S-shape, a characteristic of humans that keeps the body's mass centred over the pelvis for efficient bipedal walking (*eLife*, doi.org/g6wb).

However, previous studies of *A. sediba* had also found clear adaptations in the upper body for tree climbing, suggesting it was halfway between tree-dwelling apes and fully bipedal humans.

The new analysis backs this up, says Scott Williams at New York University, one of the study team. "It's reinforcing what has been said before," he says. ▮

Michael Marshall

"A curved spine keeps the body's mass centred over the pelvis for efficient bipedal walking"

cytiva

We're transforming biopharma manufacturing

Learn more at
cytiva.com

Cytiva and the Drop logo are trademarks of Life Sciences IP Holdings Corporation or an affiliate.
©2021 Cytiva
For local office contact information, visit cytiva.com/contact

CY24114-03Sep21-AD

Ecology

Hybrid salmon may be a result of climate change

Jake Buehler

HYBRID salmon have emerged near Vancouver Island in Canada, possibly due to environmental changes in the waterways where they hatched.

Andres Araujo at Fisheries and Oceans Canada in Nanaimo and his colleagues analysed the genes of salmon surveyed mostly within the Strait of Georgia, which separates Vancouver Island from the mainland, between 2013 and 2019. They found that samples from what they assumed to be young Chinook salmon (*Oncorhynchus tshawytscha*) had unusual genetic markers. More sampling and genetic analysis revealed that these fish were hybrids, crossed with coho salmon (*Oncorhynchus kisutch*), another species found in the region.

Many of the hybrids look like a mix of the two species, says Araujo. Some have grey-lined gums, intermediate between the Chinook's black gums and pale coho gums, for example.

Hybrid salmon have been documented before, but very rarely. In the latest study, the team found a persistent, low-level presence of hybrids, most of which were found near the mouth of the Cowichan river, an important spawning ground for the two species. The team says nearly 5 per cent of the fish sampled that are thought to have originated in the Cowichan are hybrids (*Ecology and Evolution*, doi.org/g6th).

> "There are reports of different salmon sharing spawning grounds, which is unexpected"

Araujo and his colleagues think these hybrids could be a result of the impact of climate change on the Cowichan. In recent years, dry conditions have lowered the river's water level, delaying the start of the Chinook salmon's late summer spawning. This increases the chance that the coho – which arrive and spawn in the autumn – will overlap with the Chinook spawning, possibly resulting in interbreeding.

WILL DUGUID

This fish is a mix of coho and Chinook salmon

Araujo says there have been anecdotal reports of coho and Chinook salmon sharing Cowichan spawning grounds at the same time, "which is not really what is expected".

Logging operations along the river are thought to have reduced the amount of suitable habitat for salmon spawning, which further encourages the two species to cross paths.

As more streams in the region shrink in an increasingly warm world, such hybrids may become more prevalent, the researchers say.

The team found some hybrids that reached adulthood and were able to reproduce, but interbreeding could cause problems as the hybrids may be less well adapted to their environment, says Araujo.

Michael Miller at the University of California, Davis, says he isn't convinced that hybridisation is directly linked to human activities. These two species have been in the same rivers for "thousands and thousands of years", says Miller, and have endured many low-water years with little separation in spawning.

If hybridisation does have a negative impact on salmon populations, it could have wider consequences, too. Salmon are a food source for a variety of animals, and are also both economically important to the area and deeply significant in Indigenous cultures in the region.

Araujo hopes that future monitoring programmes can use the prevalence of these hybrids as an ecosystem health warning sign, since they "might be an indicator of problems" in the river system, like low water levels. ▮

Chemical signals

Body odour makes men calm and women aggressive

Christa Lesté-Lasserre

A CHEMICAL emitted from human skin, breath and faeces has no detectable scent but can influence behaviour, making men calmer and women more aggressive.

Although scientists have yet to determine when or why people release hexadecanal, it seems clear that humans communicate subconsciously via body odours, says Eva Mishor at the Weizmann Institute of Science in Israel.

Previous studies had shown that hexadecanal acts as a "social buffer" that reduces stress in mice, she says. In humans, studies have suggested the compound triggers different brain activity in men and women, but it wasn't known how.

To find out, Mishor and her colleagues asked 67 men and 60 women – aged 21 to 34, all identifying as their gender assigned at birth – to play an online game against human or robot players. They were asked to sniff clove oil prior to playing; for half the people, the oil was mixed with hexadecanal, which didn't affect its scent.

In the game, which was designed to seem unfair after a few rounds, players could "blast" opponents with sound. The women who had sniffed the hexadecanal reacted more aggressively to the game, increasing the volume and blasting their opponents with 17.6 per cent greater intensity, says Mishor. The men responded with 18.4 per cent less volume if they had inhaled the chemical, compared with those who hadn't, she says.

Functional MRI scans showed that people who sniffed hexadecanal had increased activity in the parts of the brain associated with recognising social cues. When provoked by the game, women had more neural activity linking these regions to brain areas responsible for aggressive behaviour, while the same activity was reduced in men (*Science Advances*, doi.org/g6sh). ▮

Science policy

Nobel prize visa scheme flops

UK's prestigious prize visa route has received no applicants since it launched in May

Jason Arunn Murugesu

NOT a single scientist has applied to a UK government visa scheme for Nobel prize laureates and other award winners since its launch six months ago. The scheme has come under criticism from scientists and has been described as "a joke".

In May, the government launched a fast-track visa route for award winners in the fields of science, engineering, the humanities and medicine who want to work in the UK. This prestigious prize route makes it easier for some academics to apply for a Global Talent visa – it requires only one application, with no need to meet conditions such as a grant from the UK Research and Innovation funding body or a job offer at a UK organisation.

The number of prizes that qualify academics for this route currently stands at more than 70, and includes the Turing Award and many prizes from professional or membership bodies such as the Institute of Physics (IOP) and the Royal Academy of Engineering (RAEng).

"Winners of these awards have reached the pinnacle of their career and they have so much to offer the UK," said home secretary Priti Patel when the prestigious prize scheme launched. "This is exactly what our new point-based immigration system was designed for – attracting the best and brightest based on the skills and talent they have, not where they've come from."

> "The chances that a Nobel laureate would move to the UK to work are zero for the next decade or so"

But a freedom of information request by *New Scientist* has revealed that in the six months since the scheme was launched, no one working in science, engineering, the humanities or medicine has actually applied for a visa through this route.

"Chances that a single Nobel or Turing laureate would move to the UK to work are zero for the next decade or so," says Andre Geim at the University of Manchester, UK. Geim won a Nobel prize in 2010 for his work on graphene. "The scheme itself is a joke – it cannot be discussed seriously," he says.

"Frankly, having precisely zero people apply for this elitist scheme doesn't surprise me at all," says Jessica Wade, a material scientist at Imperial College London and a diversity in science campaigner. "UK scientists' access to European funding is uncertain, we're not very attractive to European students as they have to pay international fees, our pensions are being cut and scientific positions in the UK are both rare and precarious."

A Home Office spokesperson told *New Scientist* that the prestigious prizes route makes it easier for those at the "pinnacle of their career" to come to the UK. "It is just one option under our Global Talent route, through which we have received thousands of applications since its launch in February 2020 and this continues to rise," they said.

Neuropsychologist Dorothy Bishop at the University of Oxford says other visa routes are already fast for top scientists and says it is odd that this scheme was launched in the first place.

Andrew Clark at RAEng says his organisation is happy with the number of applications it has seen recently across all immigration routes for foreign scientists. "In many cases, applicants would be eligible for multiple routes," he says. "We wouldn't want to focus on the use of any particular route over a six-month period, but rather the overall success."

Of the more than 600 Nobel science laureates from 1901, just 23 are women. No award has ever been given to a Black laureate in a science subject. Geoscientist Christopher Jackson at the University of Manchester says an immigration system based on awards will only replicate science's lack of diversity. "Studies show that most scientific award winners are white men of European descent and often working at American universities."

Of the five people who have won the IOP's Isaac Newton Medal and Prize since 2015, not one has been a woman. Only one woman has won the RAEng's Prince Philip Medal in its history. ■

Materials science

Octopus-inspired material changes colour to blend in

MANY camouflage materials are limited by the need for power or external sensors as they effectively record video of what is behind an object to be hidden and display it on the front. Now a material inspired by octopuses and squid makes an object match its surroundings if you shine an infrared torch on it instead.

Xuesong Jiang at Shanghai Jiao Tong University in China and his colleagues have created the material from two layers, each of which has a different thermal expansion rate. One layer is infused with pigments of mixed colours and the other is made to be the same colour as the background.

When the material is cool, the layers have different tensions, which causes tiny wrinkles and creases to form on the surface. Light shone onto the surface warms up the layers, causing them to expand at different rates and making the two materials smooth again.

Creating and eradicating these wrinkles allows the colour of any reflected light to be controlled. In the wrinkled state, a mixed spectrum of bright colour is reflected, but when the material smoothes out, the reflected colour matches the background, and whatever is clad in the material becomes camouflaged (*PNAS*, doi.org/g6vt).

Because the system doesn't use sensors or power, researchers believe it could create inexpensive adaptive camouflage uniforms. The US Army has previously called for proposals for wearable camouflage with chameleon-like abilities. ■

Matthew Sparkes

DAVID FLEETHAM/ALAMY

See the octopus? Camouflage material inspired by these animals can hide an object

Immunology

Tolerance therapy could help children with milk allergies

Alice Klein

CHILDREN who are severely allergic to milk may be able to start tolerating it if they are given tiny amounts of baked milk followed by progressively larger doses, a small clinical trial suggests. Larger studies are needed to confirm the effect and the therapy shouldn't be attempted without medical supervision, say doctors.

About 3 per cent of preschool-aged children are allergic to proteins in cow's milk, making it the most common food allergy in young children. Most naturally grow out of it by the time they go to school, but one in five of them continue to be allergic as they get older.

Jennifer Dantzer at Johns Hopkins University in Baltimore, Maryland, and her colleagues tested if children with a severe cow's milk allergy – who react even to trace amounts of milk – could learn to tolerate it if they were gradually exposed to baked milk, which is typically less allergenic than raw milk.

The team randomly assigned 30 people aged between 3 and 18 with a severe allergy to either slowly have baked milk powder introduced to their diets or a placebo powder made of tapioca flour.

After one year, the children were tested with increasing doses of baked milk under clinical supervision. Eleven of the 15 who had been gradually exposed to baked milk were able to tolerate a cumulative dose of 4 grams of the powder, about half a cup of milk's worth. None of the children in the placebo group was able to reach this dose (*Journal of Allergy and Clinical Immunology*, doi.org/g6hc).

"They've really enjoyed not stressing as much about being exposed to traces of milk," says Dantzer. "It means they can order food from restaurants and not have to worry that it might have been cooked on the same grill as a cheeseburger." ▮

The internet

Cryptocurrency experiment nearly bought US Constitution

Matthew Sparkes

CED JONES/AFP VIA GETTY IMAGES

A page of the first printing of the US constitution

A CROWDFUNDING campaign that raised more than $40 million in cryptocurrency donations in less than a week has failed to buy one of 13 surviving original copies of the US Constitution at auction. But it was still an interesting test for the money-raising process – using the blockchain technology behind cryptocurrencies to quickly form and run a decentralised organisation.

ConstitutionDAO raised donations averaging more than $200 from 17,437 investors within days, something that its organisers claim is a record for crowdfunding. The project used the Ethereum network, which is a cryptocurrency-based platform that can be used to create smart contracts, such as agreements to contribute to a large crowdfunding campaign and on what will be done with the proceeds.

Co-creator Will Papper says it could be an important test for a radical new type of governance. A decentralised autonomous organisation (DAO) can function like a company, charity or special interest group, with investors, managers, rules, assets and a common goal. But unlike traditional business structures, a DAO is set out in computer code and runs autonomously.

$40m

The amount raised to buy a rare copy of the US Constitution

Several ambitious DAO projects are in progress, says Papper, such as CityDAO, which is collectively purchasing land in Wyoming to create a new city. However, he says, the attempt at buying the US Constitution demonstrates that large, disparate groups can be empowered by blockchain technology – which underpins Ethereum and other cryptocurrencies – to reach a common purpose.

Papper says that in online groups like this, people don't need to spend time forming official corporations or writing complex contracts because the way the organisation runs can be guaranteed by the computer code.

The copy of the Constitution was auctioned by Sotheby's last week with a reserve price of $20 million, well within ConstitutionDAO's budget, but the document sold to another bidder for $41 million.

Since then, there have been reports that ConstitutionDAO has had some problems. In principle, computer code should have set out exactly what would happen in the event of winning or losing the auction, but because it had been put together so quickly, this didn't happen. Like many such projects, everyone who contributed was given a token related to the amount they donated, which gives them voting rights on how the project should proceed. But the voting process was never fully worked out, according to *Vice*, meaning that people in the project were still discussing what should happen days later.

New Scientist contacted ConstitutionDAO for further comment on the aftermath but hadn't received a response when this article went to press.

Adrian Fletcher, who was previously head of blockchain at TD Bank, says that the cryptocurrency and blockchain sector is full of developers who believe they are building a decentralised future.

"Although many of these projects will fail along the way, I do think many will survive, and in the future we won't be able to remember a world without them," he says. ▮

Consciousness

Response to anaesthetic can predict if people will recover after a coma

Clare Wilson

JEFFREY GREENBERG/UNIVERSAL IMAGES GROUP VIA GETTY IMAGES

Brainwave changes under anaesthesia are a useful sign of consciousness

A TEST that involves seeing how people's brainwaves respond to a general anaesthetic may be able to predict if someone in a state of impaired consciousness will eventually recover. The test was highly accurate for 12 people in such a state – but now needs to be trialled on a larger group.

People who are in a coma after a brain injury, such as from a car accident or a stroke, sometimes emerge into a condition between coma and consciousness called a vegetative state. In this condition, their eyes may sometimes open, but they cannot respond to commands or move purposefully.

It is currently very hard for doctors to predict which of these people will recover, leading to great distress for families wondering if life support should be continued or stopped. "You need to make life-and-death decisions about someone you love, with minimal evidence – it's typically agonising," says Stefanie Blain-Moraes at McGill University in Montreal, Canada.

The new test exploits the fact that the brains of healthy people respond to anaesthesia with characteristic changes in their brainwaves, shown by placing electrodes on their scalp to administer an electroencephalogram (EEG).

When healthy people are awake, their alpha brainwaves – which have a frequency of around 7 to 14 hertz – peak at the front of the brain first, with subsequent peaks happening progressively towards the back. If they lose consciousness under general anaesthesia, the pattern flips, with the back leading.

Blain-Moraes wondered if this might be a useful sign of consciousness in people in a vegetative state. "I suspect that nobody has tried this before because most people equate unresponsiveness with unconsciousness," she says. "Why would you anaesthetise someone who you thought was already unconscious?"

Her team carried out EEGs on 12 people who were either in a coma, a vegetative state or a similar condition called a minimally conscious state, in which people may occasionally show purposeful movements, like lifting a finger when asked. The researchers used an injectable drug called propofol, often used to induce anaesthesia before surgery.

Four of the people, who were either in a vegetative state or a coma, responded to the injection similarly to healthy individuals. Three of them went on to recover full consciousness within three months. The other had their life support withdrawn soon after the test, so it is unknown if they would have recovered (*American Journal of Respiratory and Critical Care Medicine*, doi.org/g6j6).

The study results weren't available in time to be used as part of the medical decision-making for this person, and it would have been premature to change their treatment based on what was, at the time, an early-stage hypothesis, says Blain-Moraes.

The other eight people didn't show the characteristic response. Of them, seven remained in their original condition and one died.

Steven Laureys at the University of Liège in Belgium says that while the approach needs to be tested in more people, the initial results are exciting. "It's a brilliant idea," he says. "Any new approach is very much welcome. We now need to see if it's true." ▮

Space

A second trojan asteroid shares Earth's orbit

EARTH has a second partner in its orbit. Until now, we only knew of one Earth trojan – an asteroid that shares our planet's orbit around the sun – but a team of researchers has found another one.

Named 2020 XL_5, the new trojan asteroid was first discovered in 2015 by astronomers using the Panoramic Survey Telescope and Rapid Response System in Hawaii. At the time, we didn't have enough data to know whether it was a trojan, so Paul Wiegert at the University of Western Ontario in Canada and his colleagues used the University of Hawaii 2.2-metre telescope at Mauna Kea to take more observations.

They found that it is a trojan, although its orbit around the sun isn't exactly the same as Earth's – it is slightly oval-shaped and tilted, with a small wobble. "If you imagine it's a racetrack, Earth is like a car that's going smoothly around the track, and this object is driving more erratically," says Wiegert. "They're on the same track, but not always in the same lane."

Because objects like this remain close to Earth for extended periods of time, they make particularly intriguing topics for missions to visit asteroids.

> "If you imagine it's a racetrack, Earth is like a car moving smoothly and this object is more erratic"

The orbit of 2020 XL_5 brings it within 15 million kilometres of Venus – around 10 per cent of the distance between Earth and the sun – every 30 years or so. This means it is likely to be pushed out of its stable orbit in around 6000 years, after which point it will probably become "a garden-variety near-Earth asteroid", says Wiegert. The researchers calculated that it has probably been in its current orbit since 1444 (arxiv.org/abs/2111.05058). ▮

Leah Crane

Materials

Alternative plastic made from DNA is easy to recycle

Alice Klein

A NEW plastic made from DNA is renewable, requires little energy to make and is easy to recycle or break down.

Conventional plastics are bad for the environment because they are made from non-renewable petrochemicals, require intense heating and toxic chemicals to make, and take hundreds of years to break down. Alternative plastics derived from plant sources like corn starch and seaweed are renewable and biodegradable, but are also energy-intensive to make and hard to recycle.

Dayong Yang at Tianjin University in China and his colleagues have developed a plastic that overcomes these problems. It is made by linking short strands of DNA with a chemical derived from vegetable oil, which produces a soft, gel-like material. This can be shaped into moulds and then solidified using a freeze-drying process that sucks water out of the gel at cold temperatures.

The researchers have made several items using this technique, including a cup, puzzle pieces and a dumb-bell shape. The items were then recycled by immersing them in water, turning them back into a gel that could be moulded into new shapes (*Journal of the American Chemical Society*, doi.org/gngw3m).

Because the production of DNA plastic doesn't require high temperatures, its carbon emissions are 97 per cent lower than those of polystyrene plastic. It can also be broken down using DNA-digesting enzymes when no longer needed.

The two main downsides of the plastic are that it isn't as strong as traditional petrochemical plastics and it must be kept dry to stop it from turning back into a gel. As a result, it is probably best suited to applications like packaging materials and electronic devices, says Yang. ▮

Analysis **Space**

Anti-satellite weapons A Russian test that created a cloud of dangerous debris has inflamed tensions in low Earth orbit. Is there worse to come, asks **Leah Crane**

ON 15 November, astronauts aboard the International Space Station (ISS) were awoken and told to batten down the hatches and take cover. A cloud of debris from a smashed-up satellite was heading towards the station, so the seven astronauts had to shelter in their Soyuz and Crew Dragon capsules, which are more heavily protected than the rest of the craft, for two hours as it passed. They repeated this 90 minutes later as the detritus came around the planet again.

The debris came from a defunct Soviet satellite called Cosmos-1408, destroyed deliberately in a test of a Russian anti-satellite (ASAT) device. This created more than 1500 shards of satellite large enough to be tracked and hundreds of thousands of smaller bits, all hurtling around Earth about 485 kilometres up.

The ISS and all its passengers emerged from the cloud safely, and while it has since made several other close passes, none of them has caused any serious damage. But the debris could remain in orbit for years, endangering spacecraft and forcing satellites to manoeuvre out of the way.

After the test, the US government reacted quickly with outrage. "Russia has demonstrated a deliberate disregard for the security, safety, stability, and long-term sustainability of the space domain for all nations," said James Dickinson, commander of the US Space Command, in a statement. "The debris created by Russia's [ASAT] will continue to pose a threat to activities in outer space for years to come, putting satellites and space missions at risk."

The Russian space agency, Roscosmos, made an announcement stating: "For us, the main priority has been and remains to ensure the unconditional safety of the crew." Of the seven crew members aboard the ISS during the test, two were Russian.

Others in the space flight industry say that this test endangered all the astronauts currently in orbit. "I'm outraged by this irresponsible and destabilizing action," said NASA administrator Bill Nelson in a statement.

"With its long and storied history in human spaceflight, it is unthinkable that Russia would endanger not only the American and international partner astronauts on the ISS, but also their own cosmonauts. Their actions are reckless and dangerous, threatening as well the Chinese space station and the taikonauts on board," he said.

1500

Number of large pieces of debris created by Russia's weapon test

This isn't the only ASAT test that has been conducted, as the Russian defence ministry noted in a statement in which it also claimed that the debris "did not represent and will not pose a threat to orbital stations, spacecraft and space activities". China conducted a test in 2007 that resulted in some fragments that are still circling Earth – the ISS recently had to adjust its orbit slightly to avoid one. The US conducted a test in 2008 and India did as well in 2019, but both of those tests destroyed satellites in relatively low orbits, so the resulting debris fell and burned up in the atmosphere within months.

There is no international treaty officially forbidding ASAT tests, but like previous ones, this test was a display of force that won't go unnoticed by other space powers. The danger is that rather than resulting in laws against ASAT weapons, a subject that has long been contentious, this incident will provoke additional tests from other countries wishing to prove that they have similar capabilities. If that happens, it could make space a minefield of speeding rubbish for many decades. ▮

NASA

The International Space Station's crew had to take cover

Military technology

Strobe weapons used in Belarus

Flashing devices that can daze opponents deployed in border dispute with Poland

David Hambling

Polish troops guard a fence on the border with Belarus

TERRITORIAL DEFENCE FORCES OF POLAND'S MINISTRY OF NATIONAL DEFENCE VIA GETTY IMAGES

POLAND says strobe devices were used on its forces by Belarusian troops as the latter tore up a fence on the border between the nations amid a stand-off over migrants.

Strobe weapons, designed to daze or immobilise opponents with flashing light, have been developed since the second world war, but this appears to be their first use in a situation below the level of open warfare.

The incident on 12 November occurred after the European Union accused Belarus of encouraging thousands of migrants fleeing turmoil in Iraq, Syria and Yemen to come to Belarus and cross into Poland illegally. EU diplomat Josep Borrell says that these vulnerable people are being used in a disagreement with the EU that started when Belarusian president Alexander Lukashenko cracked down on dissent after a disputed election. A humanitarian crisis looms as many migrants are stuck on the border in freezing conditions.

The strobes appear to have been aimed at stopping Polish forces, deployed to prevent migrants crossing the border, from seeing what was happening as Belarusian soldiers tore out fence posts.

> "The laws of war are not designed to account for non-lethal armaments such as strobe devices"

Russia, which supplies Belarus with military equipment, has developed a variety of LED-based strobe devices. In 2019, its navy unveiled the Filin system, which was claimed to suppress vision up to 5 kilometres away.

While the US has concentrated on laser-based dazzlers or optical distractors to target a single individual or vehicle, for use at checkpoints and similar situations, the Russian devices are intended for larger operations.

The exact effect of such weapons is contentious. Some have been claimed to disorientate people, cause them to vomit or even incapacitate them. A Russian military analyst stated last year that the Filin "may cause some hallucinatory symptoms". There is no published scientific evidence for any of the effects claimed.

Robert Bunker, an analyst at security consultancy C/O Futures, says that Russia has been working on so-called psychotropic weapons, ones that can overwhelm the senses, for at least 20 years. Bunker notes that the Belarusians also used green laser dazzlers in the border incident.

"[This] represents grey-zone warfare because it goes beyond guns and bombs," says Bunker. Such devices give the Russians and their allies tools for exerting pressure without resorting to lethal weaponry.

Last month, Wendell Leimbach, a US Marine Corps colonel who manages the Pentagon's research effort on non-lethal weapons, warned that potential opponents might take the lead in this type of technology. The concern is that while lethal US firepower may outmatch opponents, they could win grey-zone conflicts with non-lethal devices like strobe dazzlers.

"The present laws of war are not designed to account for them," says Bunker. ▮

Health

Cancer cells steal mitochondria from nearby immune cells

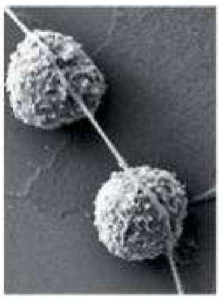
CANCER cells can boost their own growth by stealing energy-generating structures from immune cells that stray too close.

We already knew that some cell types grow nanotubes, tentacle-like structures made of a protein called actin. The nanotubes can let one cell link itself to another so the two can transport components, including energy-producing mitochondria, between them.

Now, we have our first evidence that cancer cells can do something similar by using nanotubes to hijack mitochondria from two types of immune cells: T-cells and natural killer T-cells, both of which can destroy cancer cells.

"The fact that cancer cells send out nanoscale tentacles and suck out the mitochondria is a surprising finding," says Shiladitya Sengupta at Harvard Medical School.

He and his colleagues put immune cells and cancer cells from mice in the same dish for 16 hours before studying their interactions using a microscope. They found that, on average, each cancer cell formed one nanotube with a T-cell.



Two T-cells connected by a cancer cell nanotube

TANMOY SAHA

By labelling the mitochondria inside the immune cells with a fluorescent chemical marker, the researchers discovered that the mitochondria were transferred towards the cancer cells along the nanotubes. They observed a similar effect in human cells from cancers of the thymus and breast.

What's more, cancer cells consumed oxygen at around double the rate and reproduced more often when they were placed in contact with T-cells compared with a control group of cancer cells grown near T-cells but physically separated from them (*Nature Nanotechnology*, doi.org/g6fq). ▮

Carissa Wong

The ultimate MAGAZINE for curious young minds!

From the makers of Encyclopaedia Britannica comes the ultimate magazine for curious young minds!
BRITANNICA
MAGAZINE
Introductory issue £5.99
FREE POSTER
WILL YOU BE THE FIRST PERSON ON MARS?
BRAIN-TINGLING FACTS!
AWESOME ANIMALS!
LOTS TO READ ✦ LOADS TO LOOK AT ✦ ASK THE EXPERTS ✦ QUIZ… JOKES ✦ AND…
CHRISTMAS OFFER!
NEW! MAGAZINE FOR KIDS AGED 7+
BRITANNICA ALL NEW CHILDREN'S ENCYCLOPEDIA
WHAT WE KNOW & WHAT WE DON'T

- Inspiring, fun and factual
- Will make children *want* to read – and say 'wow' on every page
- Bursting with facts, photos, quizzes, recipes, puzzles, jokes and much, much more!
- The perfect family GIFT FOR CHRISTMAS

Go to www.britannicamagazine.com, scan the QR code or call 01778 392479

CHRISTMAS OFFER!

SUBSCRIBE NOW FOR £59.99 + GET A FREE BOOK WORTH £25

Technology

Wikipedia uses AI to track down contradictions

Matthew Sparkes

THE charity that maintains Wikipedia has developed an artificial intelligence that can spot contradictory claims in articles and alert the human editors who write and edit the collective encyclopedia.

The English language version of Wikipedia has more than 6 million articles written almost entirely by volunteers. While that huge, unpaid workforce is its biggest strength, it is also a crucial weakness, and errors can be introduced either accidentally or deliberately.

Cheng Hsu at National Cheng Kung University in Taiwan and colleagues believe that AI automation can provide a way to identify errors in the vast cloud of content.

> "The artificial intelligence could dramatically increase the number of errors caught and fixed"

Working with the Wikimedia Foundation, which operates Wikipedia, the team created an AI that can detect contradictions within articles. For instance, the Wikipedia entry on musician Tyler Acord was found to claim, in the same article, that he was born in a town called Lakewood and also in a town called Renton. The software was able to spot that these facts cannot both be true and raise this as an error.

The artificial intelligence was trained on examples of contradictions flagged and corrected by Wikipedia's human editors and taught to spot contradictions on its own.

When the software was trained with 80 per cent of that data and tested on the remaining 20 per cent, it was found to have an accuracy of up to 65 per cent (arxiv.org/abs/2111.08543). This could dramatically increase the number of errors caught and fixed. ■

Coronavirus

First known covid case was Wuhan market trader after all

Michael Le Page

A FRESH analysis of the earliest covid-19 cases has bolstered the argument that the pandemic began at the Huanan market in Wuhan, China.

A World Health Organization report on the origins of SARS-CoV-2, published earlier this year, states that the first person known to have covid-19 became ill on 8 December 2019 and had no connection to the market, which sold live animals.

However, this man – a 41-year-old accountant who was living 30 kilometres from the market – went to hospital on 8 December because of dental problems and only had covid-19 symptoms on 16 December, says Michael Worobey at the University of Arizona in his analysis.

These dates are confirmed by media interviews with the man, hospital records and a scientific paper. That means the earliest known cases were indeed linked to the market. The first was a seafood vendor who became ill on 11 December 2019 (*Science*, DOI: 10.1126/science.abm4454).

Why this isn't in the WHO report is unclear, as the team did speak to the accountant. "My guess is that they were told that this was the 'December 8' patient and just accepted it as read," says Worobey.

A WHO spokesperson says: "The team did meet with some early patients, but those were not epidemiological interviews collecting health data that would put them in the timeline. Those interviews were done by Chinese authorities in 2020."

According to the WHO report, a third of 168 cases in December 2019 had links to the market. This is what one would expect if it was the source, says Worobey. The original SARS-CoV-2 virus was highly infectious and could spread asymptomatically, so many cases would lack a direct link to the source.

It has been suggested that this apparent link to the market is due to bias, as authorities began looking for cases linked to it once they were told of a possible connection on 29 December 2019. Worobey says this idea crumbles when you look at the three hospitals where doctors first realised something was up. They identified 19 unexplained pneumonia cases, of which 10 were linked to the market, before authorities were alerted. What's more, many early cases were linked to the western part of the market, which sold live animals such as raccoon dogs, a potential intermediate host for the virus to jump from bats to humans.

10

Pneumonia cases linked to Huanan market in late 2019

BJ WARNICK/NEWSCOM/ALAMY

A sign outside the Huanan market in Wuhan, China

"Combined, this is compelling evidence that covid-19 has a live-animal-associated market origin, much like the first SARS virus," says David Robertson at the University of Glasgow, UK. "Whether the initial transmissions were from animals to customers in the market, via vendors or both is hard to say."

Not everyone agrees. "There is nothing new in this article which could make a natural origin of SARS-CoV-2 more likely than a laboratory one," says Rossana Segreto at the University of Innsbruck in Austria.

But other recent findings have weakened the case for a lab origin, which some researchers say was never strong. In particular, coronaviruses that are the closest match yet found to SARS-CoV-2 have been discovered in bats in Laos. These wild viruses have features in common with SARS-CoV-2 that some had claimed could only have arisen in a lab during so-called gain-of-function experiments, showing these features can and do evolve in the wild. ■

The Spitfire, Hurricane & Lancaster Commemorative

Pure Silver and just £19.99

Struck from a half-ounce of purest silver, this new commemorative features a full colour scene of the Spitfire, Hurricane and Lancaster flying over the White Cliffs of Dover.

Now you can celebrate their legacy and own pure silver for less than £20.

Importantly, just 9,995 stunning of these historic Silver Commemoratives will be issued. To secure yours, just £19.99 **(p&p is FREE)**, simply call **0800 840 68 48** or visit us online **at www.cpm-reservations.com/9WR361U0.**

And don't worry - by ordering from CPM you're fully covered by our **30-Day Money Back Guarantee** and as stated, you won't pay a penny for postage.

Specifications: Dimensions: 38.6mm, Weight: 1/2oz, Metal: 999.9 Silver, Limited Edition: 9,995

To find out more and to reserve your silver commemorative, call **0800 840 68 48** or visit: **www.cpm-reservations.com/9WR361U0**

Numismatic pieces should be owned primarily for collector interest.CPM does not offer them as an investment and makes no guarantees in terms of future value.

POST TO: FREEPOST, CPM Distribution Office PO Box 7776, Dorset BH12 9HR

The Pure Silver Spitfire, Hurricane & Lancaster Commemorative

Max Qty: 1 per household

YES Please accept my reservation for the **Pure Silver Spitfire, Hurricane & Lancaster Commemorative** for £19.99 (FREE p&p).

MR/MRS/MISS: ______

FIRST NAME: ______

SURNAME: ______

ADDRESS: ______

______

______

______ POSTCODE: ______

PHONE NUMBER: ______

(Please help us keep you up-to-date with selected special offers)

EMAIL: ______

(Please help us keep you up-to-date with selected special offers)

PAYMENT DETAILS

☐ I enclose my cheque/P.O. for £19.99 payable to CPM

☐ Please charge my Mastercard/Visa for £19.99 on despatch. My card no. is

☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

CARD EXPIRY DATE: M M Y Y

Your credit card will not be charged until your order is despatched

App Ref: **9WR 361U 0**

SIGNATURE: ______

(I am over 18. All reservation requests must be signed and are subject to acceptance)

GOLD & SILVER COINS

All orders are subject to acceptance & status whilst stocks last. We may perform a credit check. CPM is a trading division of 288 Group Ltd. Registered in England 02000413. Russell House, Oxford Road, Bournemouth BH8 8EX.

We think you'd be interested in some of the latest offers by post from our retail partners: companies operating in the clothing, collectables, food & wine, gardening, gadgets & entertainment, health & beauty, household goods and home interiors categories. If you would prefer not to receive these, please tick this box [ ] To learn more about our partners please see our privacy policy at www.cpmcoins.com/privacy

Physics

Strange quantum effect predicted 30 years ago has finally been seen

Leah Crane

IF YOU get a dense quantum gas cloud cold enough, you can see right through it. This weird phenomenon, called Pauli blocking, happens because of the same effects that give atoms their structure, and now it has been observed for the first time.

"This has been a theoretical prediction for more than three decades," says Amita Deb at the University of Otago in New Zealand, who is a member of one of three teams that have now independently seen this.

Pauli blocking occurs in gases made up of a type of particle called a fermion, a category that includes the protons, neutrons and electrons that make up atoms. These particles obey a rule called the Pauli exclusion principle, which dictates that no two identical fermions can occupy the same quantum state in a given system.

"The same effect is responsible for why you don't fall through the floor," says Brian DeMarco at the University of Illinois at Urbana-Champaign, who wasn't a member of any of the three teams that spotted this effect. "This physics is all around you and helps determine the structure and stability of matter."

Pauli blocking occurs when fermions in a gas are packed so closely together that all of the available quantum states are filled, a form of matter known as a Fermi sea. When that is the case, the particles become unable to move, so light can't impart momentum to them. Because light that is absorbed by the particles or bounces off them would impart momentum, the light is forced to shine right through without interacting with the gas.

Laser light is used to study quantum effects in a gas of strontium atoms

CHRISTIAN SANNER, YE LABS/JILA

"This is a basic phenomenon, but it's sort of a devil to see," says Yair Margalit at the Massachusetts Institute of Technology, who is a member of one of the three research teams. "You need these extreme conditions to see it – high densities and ultra-low temperatures – and it is difficult to get both of these at once."

All three groups performed similar experiments with atoms caught in magnetic traps and then cooled to close to absolute zero. Each used a different type of atom, but they found similar results: light scattering off the gases was significantly lower when they were cold and dense enough to form a Fermi sea (*Science*, doi.org/g6fx, doi.org/g6fz and doi.org/g6fw).

"It is a great thing that three experiments came out at the same time and poke at the problem from different directions," says Deb. The results of all three were consistent with one another.

The discovery could help attempts to study atoms in high-energy, or excited, states, which tend to decay quickly.

"Imagine I take an excited atom from somewhere else and place it in this Fermi sea of atoms. When it tries to come back down from the excited state, there is nowhere for it to go, so the lifetime of that state is artificially enhanced," says Christian Sanner at the JILA research institute in Colorado, a member of one of the teams. ▮

Mental health

Calls to helplines spiked during covid-19 lockdowns

CALLS to mental health helplines rose by about a third, on average, shortly after the start of lockdowns during the early months of the covid-19 pandemic, before subsiding to similar levels as before.

There were small increases in the proportion of calls made by people feeling lonely or fearful of getting covid-19, but the nature of people's concerns stayed broadly similar to calls made before the pandemic.

Most phone helpline services for those in mental distress keep call logs, including brief notes on the reasons people rang. Marius Brülhart at the University of Lausanne in Switzerland and his colleagues analysed anonymous data from 8 million calls to helplines in 19 countries, including the US, China, Israel and several European countries, looking at the period from early 2019 to early 2021.

The number of calls peaked about six weeks after each country's coronavirus restrictions began, spiking to 35 per cent higher than before the pandemic – although some helplines initially lacked enough capacity to answer all calls and so may have missed some of the earlier calls (*Nature*, doi.org/g6fs).

The number of people calling to talk about suicidal thoughts stayed at a similar proportion of the total volume of calls as it was during 2019, before the pandemic. Other research has found that, in most countries, suicide rates haven't increased since the start of the pandemic. "We have plenty of evidence that the early pandemic affected people's mental health. We have to ask why this appears not to have translated into higher suicide rates," says Louis Appleby at the University of Manchester, UK. "Social cohesion is one possibility – family and neighbours offering support, a general sense of getting through a crisis together." ▮

> "We have plenty of evidence that the early pandemic affected people's mental health"

Need a listening ear? UK Samaritans: 116123 (samaritans.org). Visit bit.ly/SuicideHelplines for hotlines and websites for other countries.

Clare Wilson

New Scientist
Jobs

2022
GLOBAL
SCIENCE
EMPLOYMENT
SURVEY

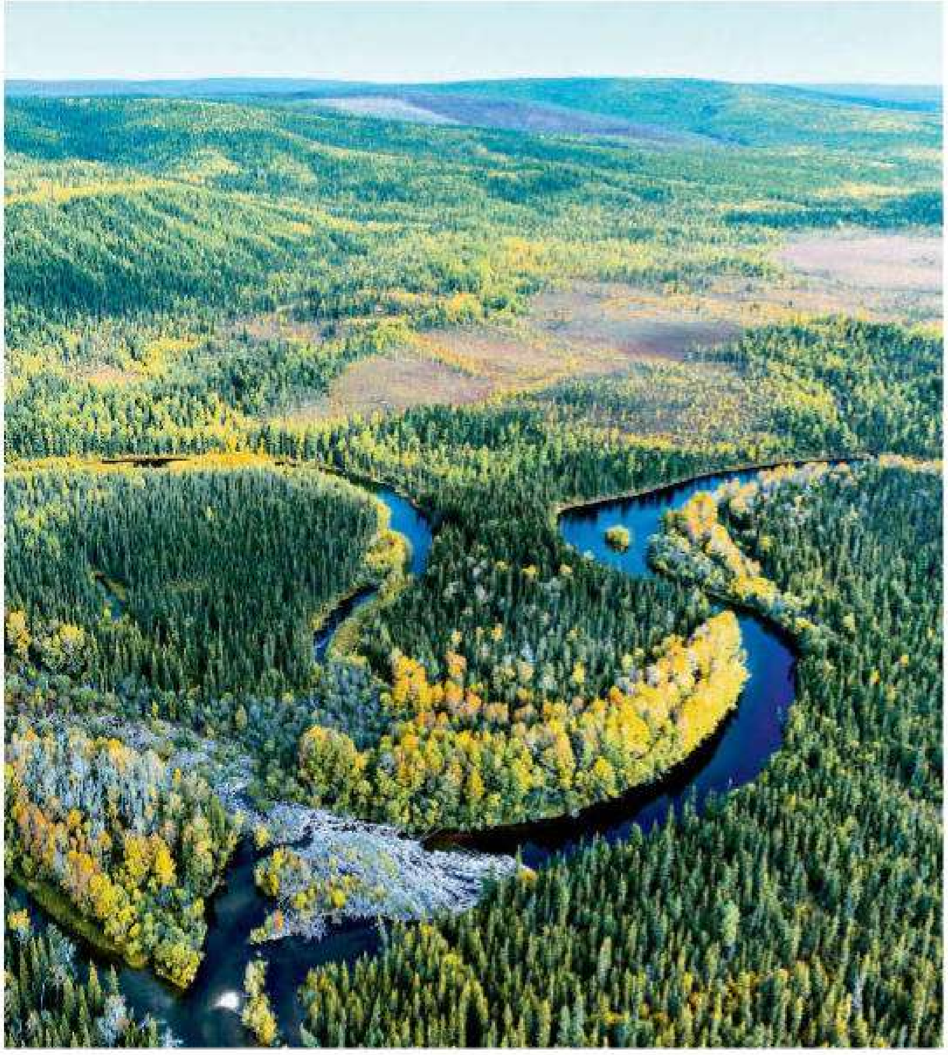
New Scientist Jobs, in association with SRG, is conducting its 2022 Global Science Employment survey to provide you with the latest insights into your industry.

We will benchmark salary data, as well as topical issues such as employee satisfaction, your employer's response to covid-19 and discrimination in the workplace. We would love your thoughts and feedback on these topics and more to help us create the survey.

To find out more and complete the survey, go to

newscientist.com/globalemploymentsurvey

IN ASSOCIATION WITH srg



OLGA KAMENSKAYA/NATUREPL.COM

Climate change

Natural carbon stores we must not lose now mapped

ONLY 23 per cent of Earth's most vulnerable and crucial carbon storage ecosystems are in protected areas. But a study that pinpoints these stores could inform efforts to keep them safe from development, while also protecting biodiversity.

Our planet locks up carbon in a range of ecosystems, such as forests and peatlands. When we degrade these for commercial purposes, such as agriculture, large amounts of carbon can be released into the air, adding to global warming.

Once released, it can take years, centuries or millennia for carbon to be stored in such ecosystems again. Stores that, if disrupted, couldn't be replenished by 2050, when the world must hit net-zero emissions to avoid the worst impacts of climate change, are said to contain irrecoverable carbon.

To map such areas, Monica Noon at Conservation International, an environmental charity based in Virginia, and her team aggregated several carbon storage data sets.

They found that half of the planet's irrecoverable carbon is stored by just 3.3 per cent of its land. The highest concentrations are in the peatlands and forests of the Amazon and Congo basin, forests of North America and Siberia, and in mangroves and wetlands elsewhere. Less than a quarter of these have protected status (*Nature Sustainability*, doi.org/g6gf).

By identifying the irrecoverable carbon hotspots, Noon hopes to encourage better nature-based solutions to tackle climate change and policies to manage and protect these crucial carbon storage ecosystems. Chen Ly

Satellites

Simpler and cheaper propulsion for space

IODINE has been used to power a satellite for the first time. This propellant performed better than the conventional choice, xenon.

Propulsion systems use a propellant – a substance expelled from a spacecraft to move it. Currently, xenon is the main option in electric propulsion systems, but it is rare and costly to produce. As a gas, xenon must also be stored at very high pressures.

Iodine has a similar atomic mass to xenon, but is more abundant and much cheaper. It can also be stored as an unpressurised solid, meaning it has the potential to simplify satellite designs.

Dmytro Rafalskyi at ThrustMe, a space technology company based in France, and his colleagues have developed an electric propulsion system that uses iodine.

It first heats up a solid block of iodine, turning it into a gas. The gas is bombarded with high-speed electrons, which turns it into a plasma of iodine ions and free electrons. Negatively charged hardware then accelerates the positively charged iodine ions from the plasma out of the system's exhaust and propels the spacecraft forwards.

The researchers tested this system in space on a 20-kilogram satellite, launched on 6 November 2020 and placed in orbit at an altitude of 480 kilometres. The system was successfully used 11 times in a series of small manoeuvres up to 28 February 2021 (*Nature*, doi.org/g6fc).

"If we want sustainable space exploration, where we don't create as much space junk as today, we need to put propulsion systems on all satellites," says Rafalskyi. This could allow a satellite to come back to Earth instead of staying in orbit at the end of its life, he says, and "it seems iodine is one of the ways to reach that goal". CL

Neuroscience

Genes in brain seem remarkably versatile

THE genetic code in human brain tissue is much more complex than we realised, with some genes potentially encoding tens or even hundreds of different proteins.

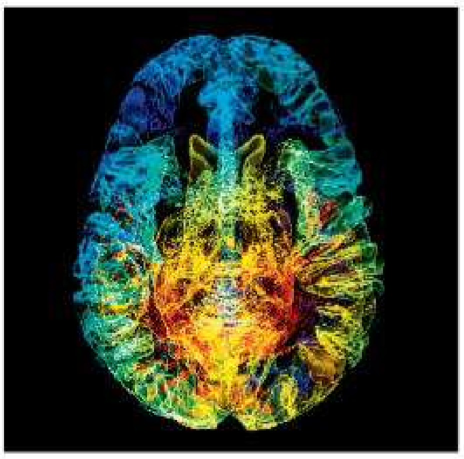
When cells make proteins, first a gene is used as a template to build a copy in the form of mRNA. The mRNA sequence is then used to create the protein it codes for.

Not all of every gene is used, though, as genes consist of several stretches of protein-coding DNA called exons, interspersed with segments called introns that are normally thought to be snipped out from the mRNA, allowing the exons to be "spliced" together.

It has long been known that some genes can produce slightly different mRNA sequences, as not all exons are used. More recently, it was discovered that some introns may not be removed.

Now, Jonathan Mill at the University of Exeter, UK, and his team have used new sequencing techniques to characterise and quantify all the mRNA in cells from the cerebral cortex, an outer part of the brain that is important in complex thought processes.

From the nearly 13,000 genes active in the cerebral cortex, they found almost 33,000 different mRNA molecules. About a fifth of the genes produced mRNAs containing introns, and more than 200 genes made between 10 and 100 different mRNAs (*Cell Reports*, doi.org/g6d6). Clare Wilson



K H FUNG/SCIENCE PHOTO LIBRARY

New Scientist Daily
Get the latest scientific discoveries in your inbox
newscientist.com/sign-up

Really brief

RON MILLER/SCIENCE PHOTO LIBRARY

Extinction began with volcanic winter

The end-Permian mass extinction event may have begun when volcanic eruptions cooled the climate and destabilised ecosystems, suggests an analysis of rocks in China. This preceded eruptions in Siberia (imagined in the image above) that caused global warming (*Science Advances*, doi.org/g6ds).

Genome data can't be linked to faces

Our facial features are determined almost entirely by DNA, but this doesn't mean that anonymised genomes shared for medical research can be linked to specific people using photos, according to a team who tried – and failed – to do so using data from volunteers (*Science Advances*, doi.org/g6dt).

AI predicts species that could get covid

The likelihood of 5400 mammal species spreading the SARS-CoV-2 virus has been predicted using an AI tool given information on their cellular biology and ecology. It identified 540 species as most likely to spread covid-19, including mink and Sunda pangolins (*Proceedings of the Royal Society B*, doi.org/g6d3).

Biology

Vital step in embryo development studied

WHAT happens in the first weeks after a human embryo implants in the uterus has been a black box. Now, biologists have had a chance to study this stage of development in detail for the first time.

The first week of development can be investigated by growing spare IVF embryos, while embryos older than 12 weeks are often donated for research by people after abortions. But samples of the stages in-between are exceedingly rare because few people realise they are pregnant and choose a termination at such an early stage.

Biologists have been keen to study a process called gastrulation, which starts two weeks after a human egg is fertilised and a week after implantation. At this point, the embryo is a hollow ball made of a single layer of identical cells. It then folds to form a multilayered structure and the cells start to take on specialised roles.

Understanding this stage could lead to better ways of turning stem cells into treatments for disease and injury, says Shankar Srinivas at the University of Oxford.

A donated embryo just 16 to 19 days old and in the process of gastrulating has now been studied by Srinivas and his colleagues.

They looked at which genes were active in every cell, and found that gastrulation in humans is broadly similar to that in mice and monkeys, but with some key differences. For instance, some so-called growth factors that control the fate of cells are different. The blood system was already starting to form, earlier than expected from mouse studies (*Nature*, doi.org/g6fp). **Michael Le Page**

Infectious diseases

JIM GATHANY/CDC

Vaccine flags up tick bites in time to avoid Lyme infection

A VACCINE that uses mRNA to create an immune response to ticks so they can be removed before transmitting Lyme disease has been shown to work in guinea pigs. It could pave the way for clinical trials in people.

Lyme disease is usually caused by the bacterium *Borrelia burgdorferi*, spread through tick bites. It can cause lifelong health problems.

Erol Fikrig at Yale University and his team have developed a vaccine that trains the immune system to respond to tick bites, by exposing it to 19 proteins found in tick saliva.

The vaccine contains mRNA molecules that instruct cells to make these proteins. Guinea pigs given the vaccine developed red, itchy rashes when bitten. The ticks also tended to detach early.

The researchers placed ticks carrying Lyme disease-causing bacteria on vaccinated and unvaccinated guinea pigs. The ticks were removed from the vaccinated animals when skin rashes emerged, usually in the first 18 hours, and none became infected. In contrast, half of the unvaccinated animals were infected (*Science Translational Medicine*, doi.org/g6d2).

If the vaccine works in people, it will enable us to see a bite early. The tick can then be pulled off before there is an infection risk. Alice Klein

Technology

Robot rattles can be used to echolocate

SOUNDS made by wheels, joints and motors on robots are usually undesirable, and engineers try to minimise them. But a study has found that they can be useful as part of an echolocation system to aid navigation and avoid crashes.

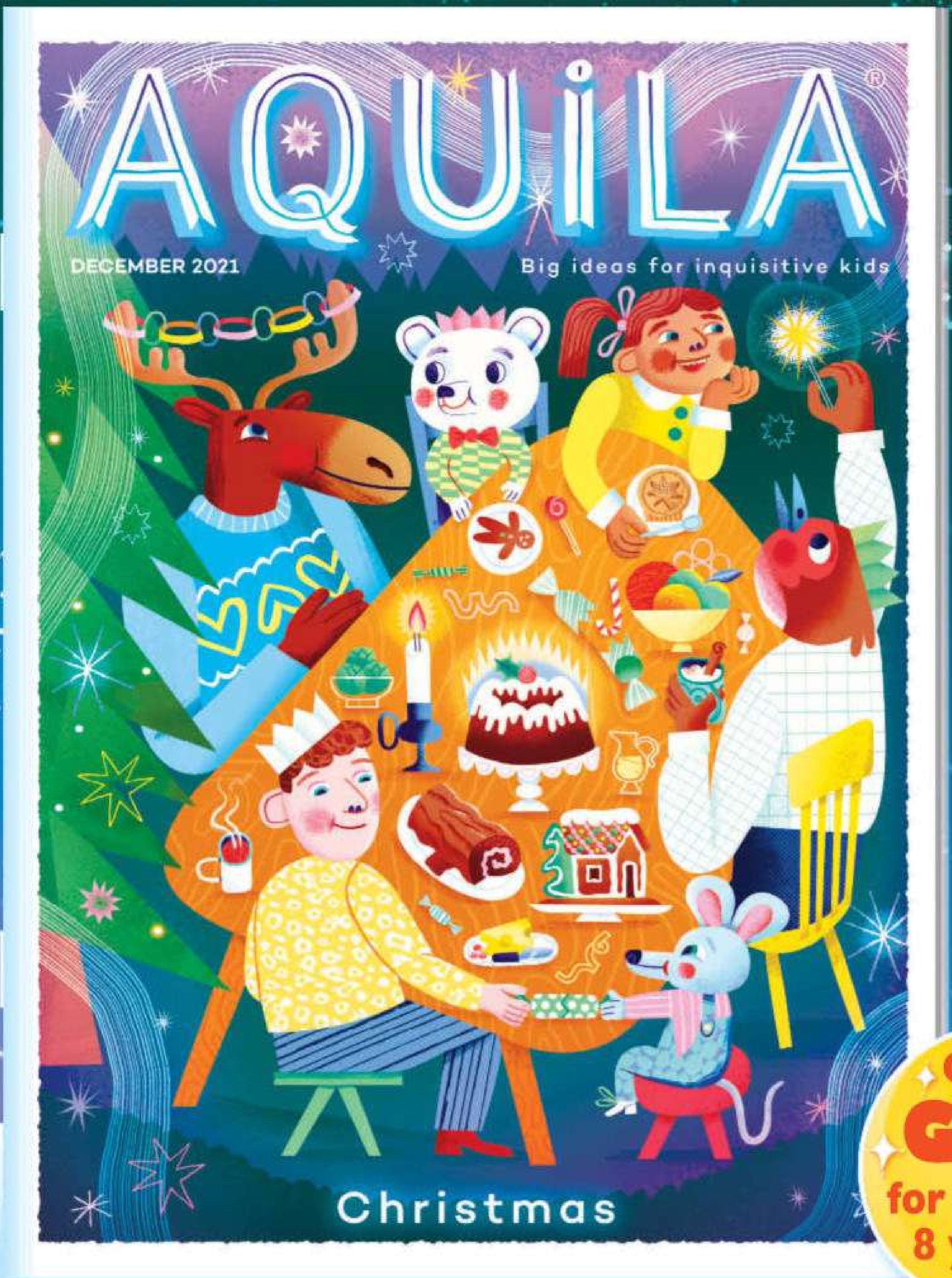
Most robots, whether they walk, roll or fly create some noise. Now, Jesper Rindom Jensen at Aalborg University in Denmark and his team say this can be used to detect obstacles by picking up sound reflected from them.

Robots often use infrared, ultrasonic or laser sensors to detect objects, but using audio can cut the power requirements, weight, complexity and cost involved. By simply measuring the time taken for noise from the robot to reach a surface and be reflected back to a microphone, a computer on board can spot obstacles up to a metre away.

The team had earlier created a device that used a loudspeaker to beam sound to navigate. But tests in a lab have now proved that the background noise created by the machine can do the same thing (arxiv.org/pdf/2111.08327).

Jensen says this could cut the cost of robots, many of which already have a microphone that can be used. **Matthew Sparkes**

AQUILA CHILDREN'S MAGAZINE



Great GIFT for children 8 years +

A Feast of Learning & Laughter…

Join AQUILA's Celebration of Christmas around the globe: read about reindeer superpowers and elf mythology, make a beautiful Kraków szopka (nativity scene) and have fun with Christmas mischief and pranks!

A subscription to AQUILA Magazine makes the perfect gift for curious young readers. Witty and intelligent with beautifully illustrated topics, every issue is a balanced mix of Science, Arts and General Knowledge.

"…Advanced & Philosophical, Curious & Puzzling"

Richard Robinson, Brighton Science Festival

A Wonderful Christmas Surprise!

AQUILA Magazine by post every month. Order now so the first copy arrives in time for Christmas with a gift message.

Order now: Christmas issue + Gift message **AQUILA.co.uk** / call 01323 431313

Views

The columnist
Tech companies don't get sci-fi, says **Annalee Newitz** p26

Letters
Half a century is too long to wait for net zero p28

Aperture
Scenes from historic expeditions around the world p30

Culture
Break the Internet is a detailed look at online influencers p34

Culture columnist
Sally Adee on a sci-fi collection about inherited biases p36

Comment

The maths divide

We could improve people's perception of maths by playing down the Platonists, suggests **Michael Brooks**

SIMONE ROTELLA

WE HAVE a problem with maths. Our approach to the subject has led to a situation where 30 per cent of US adults are defined as having "low numeracy": they can't make calculations with whole numbers and percentages or interpret simple statistics in text or tables.

Some 49 per cent of UK adults – 17 million people – have no more numeracy than we expect of primary school children. Around 93 per cent of US adults describe themselves as experiencing some level of "math anxiety", involving negative emotions – and possibly an elevated heart rate, clammy hands and dizziness – when asked to interact with mathematical problems.

I blame this on our obsession with the ancient Greeks. Many of our intellectual traditions hark back to this time and place, from the scientific use of Greek letters to the adoption of the Greek term "academia" as our society's repository of knowledge. Last week, a new exhibition opened at the Science Museum in London that celebrates the ancient Greeks as thinkers who embraced a fusion of arts, science and religion as they "sought to understand the world in a logical and mathematical way". But that depends on how you view logic and mathematics.

Is it logical to assume that "all is number", as the Pythagoreans did? This led them to give certain numbers a special status and to dismiss the idea of nothingness, and thus zero as a number. While accepted in Chinese and Indian cultures, negative numbers were also impossible for the ancient Greeks to accept.

And what is actually divine about the "divine proportion", sometimes known as the golden ratio? Although we often give the idea credence, there is no evidence that humans naturally credit this mathematically derived geometry with special aesthetic powers, as disciples of Euclid contend. The Greeks routinely ascribed mystical powers to shapes and forms: Plato described the 12-sided dodecahedron as the shape that God used "as a model for the twelvefold division of the Zodiac". But there isn't anything holy about this geometric form. Sometimes a shape is just a shape.

Putting such ideas on a pedestal is problematic because it has created a cloud of awe and "otherness" around mathematics. This has percolated through to how we teach it and how it is received. Maths is endowed with an almost sacred status for the power of numbers. Those who share this faith become insiders. Those who don't feel excluded.

Among significant numbers of school students, this results in a sense that maths "just isn't my thing", creating anxiety about having to deal with it. In the UK, 36 per cent of 15 to 24-year-olds experience maths anxiety. Some young people even have feelings of "despair and rage" about maths. The evidence shows that this anxiety lasts into adulthood, as does abandonment of the subject. Only one in five UK adults say they would be proud if their child were good with numbers, compared with one in two for reading and writing.

Celebrating a non-Greek, more utilitarian approach to numbers could help here – and would be much more faithful to the true history of mathematics. Sumerian construction workers used what we call Pythagoras's theorem to create perfectly square corners long before the Greeks arose. The Babylonians used algebra as a tax-calculation tool. At the time of the ancient Greeks, Indian thinkers were using negative numbers in debt management.

Mathematics is a social utility, like law and democracy. It isn't a religious movement. Perhaps we should solve this problem like the ancient Sumerians did, by grouping maths among the humanities, rather than as an adjunct to the natural sciences. Maybe then maths will finally belong to us all. ▮

Michael Brooks is a consultant for *New Scientist* and author of *The Art of More*

This changes everything

Why tech companies don't get science fiction

Facebook's rebrand as Meta shows that the company doesn't understand irony – and that is deeply worrying, writes **Annalee Newitz**

Annalee Newitz is a science journalist and author. Their latest novel is *The Future of Another Timeline* and they are the co-host of the Hugo-nominated podcast *Our Opinions Are Correct*. You can follow them @annaleen and their website is **techsploitation.com**

SURREAL news from Silicon Valley: Facebook has rebranded itself as Meta. This is because the company's boss, Mark Zuckerberg, wants to launch a product called the metaverse, a shared virtual reality world. Let's leave aside the fact that the metaverse is, for the moment, still a fictional idea. This is also an insanely bad episode in branding that would be hilarious if it weren't so depressing.

Imagine you are Zuckerberg meeting your crack team of brand experts. A few years ago, you bought a company called Oculus that makes virtual reality headsets and now you have figured out what to do with it. You want to leverage it to launch a new virtual world.

After an intense brainstorming session, you have it! Why not rebrand your whole empire using the name of a virtual world from *Snow Crash*, a 1992 novel in which an insane media mogul ruthlessly controls access to the Metaverse, forcing everyone to buy subscriptions to his cable service?

Wait, it gets better. Once this mogul has suckered the masses inside his Metaverse, he unleashes a "neuro-linguistic virus" that robs people of their ability to use language, eventually causing their brains to "crash" in a terrifying biological equivalent of the blue screen of death. It is perfect: you can celebrate your new corporate vision with a name that evokes media dystopia and mass insanity.

We can't, of course, know if this is exactly how Zuckerberg's thought process went. But Silicon Valley does have a record of borrowing inappropriate names from science fiction. In 2003, billionaire investor Peter Thiel named his software firm Palantir after a magical surveillance device from *The Lord of the Rings*. The catch? Merely that the fictitious palantír lies to its users as often as it reveals the truth. Kind of an awful choice for a company that was doing data analysis for intelligence agencies.

But hey, maybe execs would learn from the gaffe? Nope. A few years ago, entrepreneur Rob Rhinehart named his food-replacement drink Soylent, after the nutrition wafers made from the bodies of dead people in the 1970s movie *Soylent Green*.

Tech is an industry nobody has ever accused of nuanced self-awareness. But I don't think this cluelessness is because techies don't read. I think the problem runs far deeper: it is that tech executives have no sense of irony.

> **"Silicon Valley has a track record of borrowing inappropriate names from science fiction"**

The first step in understanding irony involves holding two contradictory thoughts together and navigating the dangerous, sometimes absurd ambiguity that lurks between. When I was a professor teaching cultural studies at the University of California, Berkeley, this was one of the hardest lessons for my students: a story can have two contradictory meanings, both of which are "correct". Often, that is the point.

The Metaverse in *Snow Crash* is cool and useful; it also makes its users vulnerable to corporate manipulation and madness. Sometimes cool things are awful at the same time.

But in the Boolean logic world of Silicon Valley, there is no room for ambiguity. A thing is cool or not, and we measure it in how many users or dollars the thing attracts.

This failure to grasp irony also explains another common problem with many big tech companies: their inability to deal with the many contradictory ways that their products can be used. An app like Facebook can be used to find love or to sow hate; to spread lies or reveal truths. It can amplify the voices of the oppressed and also lead to their oppressors tracking and silencing them. But the company fails miserably when it comes to dealing with this.

Like many other social media companies, Meta plans robustly for one or two very nice uses for its apps. Negative uses are considered marginal edge cases, assigned the lowest priority and the fewest resources. In other words, Meta doesn't understand that the awesomeness and horror of its products are equally meaningful and require equal attention.

As we look ahead to what Meta's metaverse will bring, we have to assume that the company will build a three-dimensional virtual world with the same foibles it exhibits in the 2D digital one. We already know that Oculus headsets, which will be key to navigating the metaverse, are capable of mapping people's homes in 3D and uploading the blueprints to the cloud. When you enter the metaverse, you might be sending Meta a map of your home and data on your body movements. It is easy to imagine companies using the metaverse to track if employees are keeping their eyes glued to their work.

Worst of all, Meta's lack of irony means it doesn't understand why controlling the metaverse could be good for the company, but bad for people in general. Hopefully humanity won't be reduced to the gibbering crash-heads from *Snow Crash* before we figure it out. ▮

Annalee's week

What I'm reading

Being Seen, *a memoir by Deafblind author Elsa Sjunneson about the future of disability.*

What I'm watching

Dune. *I watched it twice! Interstellar ships and exoplanetary mining equipment never looked so good.*

What I'm working on

A story about the decaying Marconi radio receivers off the coast of California.

This column appears monthly. Up next week: James Wong

THE SALVATION ARMY

CHRISTMAS APPEAL 2021

Help us be there for someone in need this Christmas

£19 could help buy a box of groceries, so a family struggling in poverty can share a basic Christmas meal together.

£38 could help meet the cost of an officer to run a Salvation Army centre for a day – to keep the door open for vulnerable people.

£63 could provide an hour of one-to-one support work for seven homeless people in one of our centres.

£112 could provide Christmas dinner and companionship for 50 lonely older people.

You can make a donation by phone or give online

08000 926 926 Quoting Ref PR48

salvationarmy.org.uk/donate

Here is my Christmas gift to The Salvation Army

£19 ☐ £38 ☐ £63 ☐ £112 ☐ Other £ ☐

A Christian Church and Registered Charity No. 214779 and in Scotland SC009359

Title ____________ Name ____________

Address ____________

____________ Postcode ____________

Email ____________

Registered with FUNDRAISING REGULATOR

Make cheques payable to: **The Salvation Army**

Please return to: Freepost RTLT-UCTS-ZAKJ, The Salvation Army 501, 99-101 Newington Causeway, LONDON, SE1 6BN

We would like to keep in touch with you about our work and how you can support us. We will keep your data safe and secure. Please read our privacy statement by visiting salvationarmy.org.uk/privacy-statement. You can change your preferences at any time by contacting us on 020 7367 4800 or fr@salvationarmy.org.uk.

☐ Yes please, I'd like to hear from you by email. ☐ No thank you, please **do not** contact me by post.

DM37448

Editor's pick

Half a century is too long to wait for net zero

6 November, p 10

From Chris Ford, Walsall, West Midlands, UK

Adam Vaughan sees hope in the fact that India's prime minister has pledged that the country will achieve net-zero emissions by 2070. However, promises made by ordinary people, let alone politicians, for 50 years in the future are clearly meaningless.

Imagine if Lenin had promised a global utopia by 1967, following the October Revolution in 1917, or if the Allies at the end of the second world war had promised enduring world peace by 1995. What we need to hear is what they will do today.

One easy way we can turn down Earth's thermostat

6 November, p 9

Ingrid Newkirk, People for the Ethical Treatment of Animals, Washington DC, US

Hurrah that many nations have pledged to stop razing forests by 2030, but, at the rate they are being felled, will any be left by then?

Reactions to the COP26 climate summit show that while many are unhappy with the failure to take the kind of drastic actions needed to save us from tempests, droughts, fires, floods and species extinction, most people behave like dependent children, leaving it to others to protect them. We need to take personal responsibility.

Most forests are destroyed to grow crops to feed cows and chickens. The way to silence the chainsaws is to end demand for meat and dairy. We can all do this.

Time to wheel out the CO_2-sucking machines

23 October, p 36

From Trevor Randall, Great Missenden, Buckinghamshire, UK

COP26 focused on persuading all nations to aim for net-zero carbon emissions by 2050, in the hope this will prevent global temperature rising by any more than 1.5°C.

The major polluters are unlikely to meet the first target, and so the second will probably be exceeded in the near future. Hence, we need massive investment in the technology to capture carbon dioxide from the atmosphere. This gas can be liquefied and buried.

The resources of the fossil fuel industries should be switched to this purpose as a matter of urgency and the UN should set up a Centre for World Temperature Control. The global temperature has already reached 1.2°C above pre-industrial levels and clearly even this is far too high.

Maths makes your daily commute less jarring

13 November, p 44

Cedric Lynch, Potters Bar, Hertfordshire, UK

In your story about the upgrade to the branch of maths called calculus, you say "you could perhaps imagine calculating the rate of change of acceleration too, which would be a third-order derivative".

However, calculating this rate of change can be of more than just obscure academic interest. In the early 1970s, it saw practical use in the development of a new train, which from 1976 to 2019 was the mainstay of the service to my home town. Because it was designed for routes with frequent stops, this train was capable of very rapid acceleration.

Experiments were done to find out how large abrupt changes of the rate of acceleration could be before passengers would object to them. This information was used to determine how to set up the train's motor controller, in order to limit acceleration changes.

Perhaps 'burial' was really just a game gone wrong

13 November, p 9

From Carole Rushall, Middlesbrough, North Yorkshire, UK

The skull of a small child found on a ledge in a cave with no signs of carnivore activity or large-scale water movement doesn't indicate to me that it is firm evidence of the early human species *Homo naledi* burying its dead. Young children hide in nearly inaccessible places as part of their games. Child's play could be a plausible explanation.

Votes for reality despite the quantum puzzle

6 November, p 38

From Martin van Raay, Culemborg, the Netherlands

Regarding Albert Einstein's wish, amid conundrums on the nature of reality thrown up by quantum theory, that he could be sure the moon was still there if he wasn't looking at it. I wonder if a related question sheds any light on this: is the sun there if I am not seeing it at night? As the moon is visible thanks to reflected sunshine, the answer is: yes, the sun is there, as you know by seeing the moon.

My guess is that reality is real at our macroscopic level, because the uncertainties at the microscopic level disappear when you zoom out. The result of a single coin flip is uncertain, but there is certainty that a million flips give a roughly 50-50 split of heads/tails. Large numbers take the uncertainty out of reality; in fact, large numbers make reality. That is why we get such strange results if we look at tiny objects or just a few of them.

From David Myers, Commugny, Switzerland

Quantum mechanics doesn't predict that the moon isn't there when you aren't looking at it, but that you can't simultaneously measure its position and momentum (and other properties) with absolute certainty. However, the uncertainty is defined by Planck's constant, which is so small that the effect is insignificant for visible objects.

Recycling metals can ease the renewable transition

13 November, p 38

From William Hughes-Games, Waipara, New Zealand

The increased demand for minerals to build renewable energy kit, such as wind turbines, solar panels and mega batteries, emphasises the need for a circular economy in which the necessary minerals, once extracted from the ground, are never reburied as waste, but reused again and again.

It also highlights the necessity of using, when possible, minerals that are common and easily found. For instance, there are liquid metal batteries that use only antimony and calcium, batteries that use only zinc and bromine and other versions based on iron and vanadium. Any innovation that reduces the use of less common metals should be promoted.

Two brain health boosts for the price of one

6 November, p 46

From Geoff Harding, Sydney, Australia

I have an idea regarding lifestyle approaches to try to reduce the chance of developing Alzheimer's disease. Older people aren't in a position to wait for a drug cure, so every beneficial lifestyle strategy should be practised.

Two important ideas have been suggested: getting seven hours of sleep and taking on a cognitively challenging activity. These can be combined if you study a difficult language such as Latin just before bedtime. In my experience, sleep follows quickly. ▮

Want to get in touch?

Send letters to letters@newscientist.com; see terms at newscientist.com/letters

Letters sent to New Scientist, Northcliffe House, 2 Derry Street, London W8 5TT will be delayed

New Scientist
Subscriptions

15	75	34	7	117
P	**Re**	**Se**	**N**	**Ts**
Phosphorus	Rhenium	Selenium	Nitrogen	Tennessine
Non-metal	Transition metal	Non-metal	Non-metal	Halogen

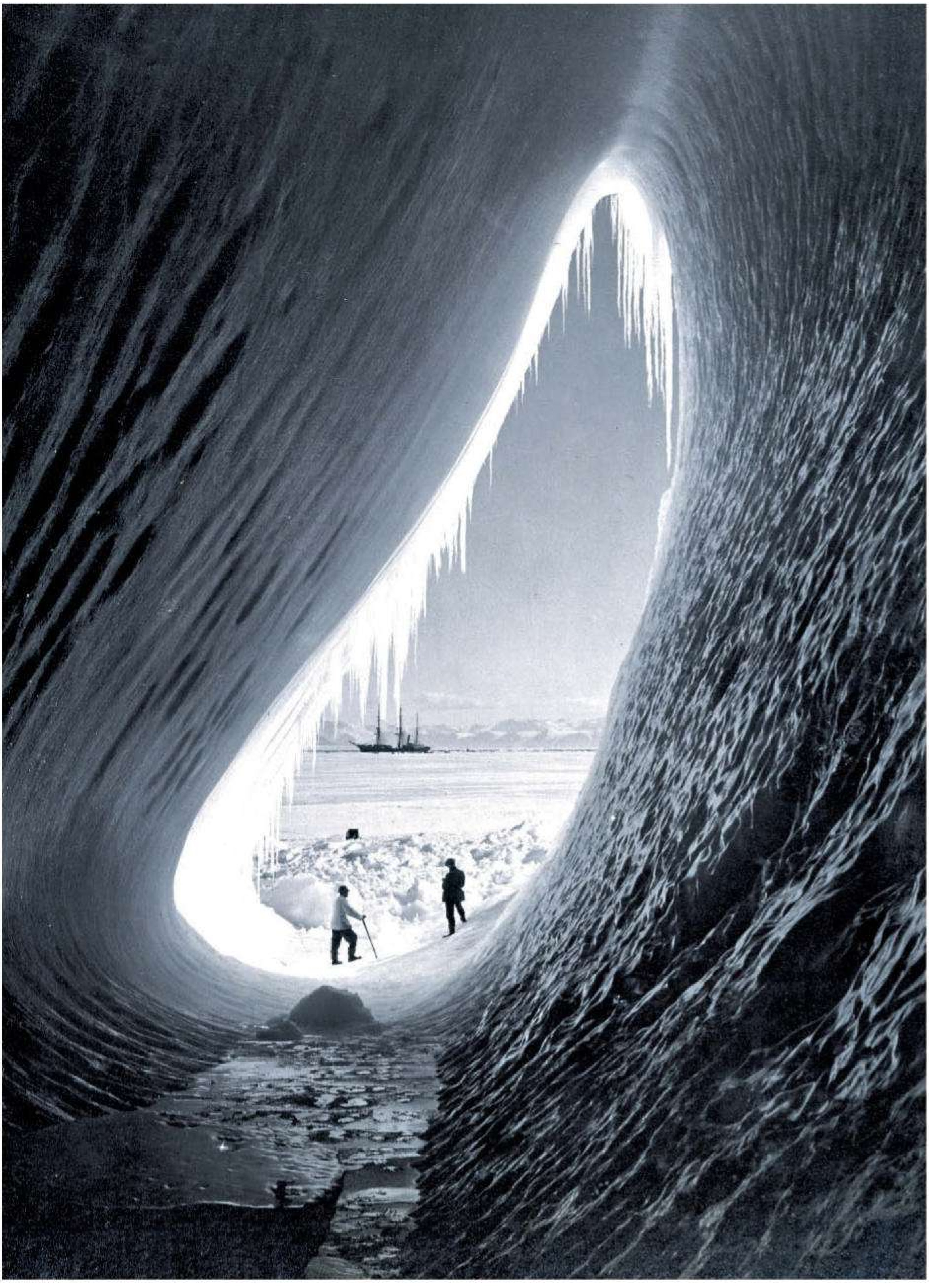
The perfect gift this Christmas? That’s elementary.

GIFT SUBSCRIPTIONS
FROM JUST JUST £49.99*
PLUS FREE
GIFT-BOXED ISSUE**

Treat yourself or a loved one to a subscription to the world’s best-informed science magazine. Plus, if you’re buying as a gift, you’ll get a free gift-boxed issue to give to your recipient.

To subscribe or give as a gift, visit
newscientist.com/element
or call: +44 (0) 330 333 9470, quoting 17121

*Price based on a 13-issue gift subscription of *New Scientist* on print, digital and print + digital options. **Free gift-boxed issue contains issue dated 11th December and a gift card and is available on print and print + digital gift subscriptions in UK only. The gift-giver will be sent the gift-boxed issue to give to the recipient. Order by 14th December to guarantee pre-Christmas delivery and by 7th December to guarantee delivery by 17th December. This will enable you to meet the last Christmas post deadline if you wish to post the gift box on to the recipient within the UK. You can continue to order after 14th December but we cannot guarantee pre-Christmas delivery. In the unlikely event that you wish to cancel your subscription, we offer a 14-day cooling off period after initial payment is made. Offer ends 31st December 2021



Epic endeavours

Photos Royal Geographical Society (with IBG)

MAGNIFICENT adventures are captured in this selection of images from the ongoing Lights and Shadows exhibition, organised by the Royal Geographical Society in London.

The scenes from travels and expeditions on display are taken from the society's historic image collection, and reveal the marked progress of photography between 1851 and 1962.

Antarctica's striking vastness is captured in the left-hand image by Herbert Ponting, photographer and film-maker for the British Antarctic Expedition from 1910 to 1913, led by Robert Falcon Scott.

The top-right image was taken in 1935 on Kellas Peak, which is on the border between India and the Tibet region and is named after Scottish mountaineer and chemist Alexander Kellas.

The four smaller images show, clockwise from top left: Mount Fuji in Japan, taken by Ponting in 1907; Tenzing Norgay and Edmund Hillary – the first people to summit Mount Everest, in 1953 – drinking tea in the Western Cwm valley that forms part of the route up the mountain, taken by fellow expedition member George Band; waves from the Southern Ocean crashing aboard the cargo vessel Moshulu in 1939, taken by apprentice seaman Eric Newby; and, finally, the crew of the lifeboat James Caird, which included Ernest Shackleton and expedition photographer Frank Hurley, pulling the boat across Antarctic ice after their ship, Endurance, sank in 1915.

Lights and Shadows is at the Royal Geographical Society in London until 10 December, and also online.

Gege Li

h
桜
v
ANRAKUTEI
4F
炭火串焼
酒場牧場
劇場通り一番街
焼肉
和牛
流れる楽しいお店♪
XROSS
CASA
Trattoria
Pizzeria
湖南
4F
菜館
2F
Tuna Rest
金枪鱼

aramco

powered by how

V

can we deliver
one of the fuels
of the future?

Hydrogen could play a pivotal role in tomorrow's energy mix, but it is expensive to transport. How can we make it commercially viable to deliver this clean energy around the world?

This question powered one of our most ambitious pilot projects to date – a supply network demonstration covering the complete hydrocarbon value chain, including the conversion of hydrogen to blue ammonia for safe and cost-effective shipping. In 2020, in partnership with the Institute of Energy Economics Japan and our subsidiary SABIC, we successfully shipped forty tons of blue ammonia to Japan for various cleaner-power generation applications.

Discover how we are catalyzing new pathways to cleaner fuels at **aramco.com/poweredbyhow**

Who runs the world?

Don't be too quick to write internet superstars off as vacuous kids – they are the future of politics, culture and industry, finds **Elle Hunt**

Book

Break the Internet: In pursuit of influence

Olivia Yallop

Scribe UK

KOVACICLEA/GETTY IMAGES

Social media influencers are increasingly defining what our culture looks like

SINCE the word "influencer" started to take on new meaning in the mid-2010s, it has been tied to an image of a young woman hawking dubious diet teas to boost her currency on social media.

If that has ever been accurate, it is increasingly less so. Influencers – a broad church spanning content creators, internet celebrities and anyone who profits from online attention – are an increasingly powerful cultural force, an "economy of influence" that is predicted to be worth $24 billion by 2025.

In her new book, *Break the Internet: In pursuit of influence*, digital strategist Olivia Yallop argues that we should take the phenomenon seriously before it takes over our culture altogether. What influencers do – even what influence is – remains a slippery concept, and sometimes even those in the business don't answer to the title.

"I would be wary of anybody who describes themselves as wanting a career as an influencer," Dominic Smales, the founder of Gleam Futures, the first influencer management agency, told Yallop in 2018. "The word is too homogenous and faceless to be meaningful."

Because of this, setting the boundaries of what influence is and the ways in which it is significant isn't an easy task, particularly given the volume of information on the subject and the breakneck speed with which it is being added to. You might wonder how long Yallop's book will feel contemporary as the economy of attention evolves. But the fast pace of change justifies this thorough, clear-eyed account of how the land lies now.

Break the Internet does well to define the sprawling parameters of influencing. Each chapter looks at a particular aspect of life as an online content creator – from gaining a following to monetising it. The accounts of mumfluencers, who focus their online profiles on their children, and influencer Caroline Calloway, who became internet famous for sharing the ups – and downs – of her life, make for especially uncomfortable reading.

Yallop is an authoritative guide, balancing her experience at a digital agency (where she worked as a go-between for influencers and brands) with the necessary critical distance of someone with only a few hundred Instagram followers.

Her analysis benefits from being grounded in rigorous, real-world reporting, with Yallop taking part in an influencer boot camp, attending meetups of "stans" (fans) and "snarkers" (the opposite) and visiting a "creator house", where teenagers live to produce content for TikTok.

> **"If Yallop is right that we are all becoming influencers, what does that mean for who we are to each other?"**

The glossary of terms and careful attention to attribution and referencing also elevates *Break the Internet* to a comprehensive account of a phenomenon that seems more likely to explode than to go away.

The book argues against "seeing influencers as a siloed industry" and in favour of instead reckoning with their already substantial and rapidly escalating importance to culture, politics and social trends.

"In the same way that we don't speak of an 'internet industry', one day we won't speak of the 'influencer industry' either," Yallop writes. "Soon, all companies will be media companies, everyone will be a brand, everything will be subject to influencer principles."

On the case for influencing as a cultural force to be reckoned with, *Break the Internet* is compelling and persuasive. Where it falls down is in making the stakes of the growing influencer economy feel real for those of us on the fringes who keep the online world turning with our attention.

We might conceive of ourselves as passive, as part of an "audience" or "following" – but if Yallop is right that we are all becoming influencers, what does that mean for who we are to each other?

As ever with writing about technology, the challenge is in centring the human element. As thorough as Yallop is in depicting the influencers' world, the personalities and the platforms, after a while, the steady stream of larger-than-life avatars, fleeting controversies and large numbers of views, likes and followers become somewhat numbing – not unlike the experience of being on the internet itself. ■

Elle Hunt is a journalist based in Norwich, UK

Animal magic

Breathtaking footage makes Netflix's new nature documentary series stand out from the herd, finds **Gregory Wakeman**

TV

Animal

Netflix

THERE is nothing wholly original about the concept of Netflix's latest nature documentary series, *Animal*. Dramatic hunt scenes? Check. Epic scenery? Check. Cute and cuddly animals? Check. It is all fairly standard fare.

Animal does stand out from the many other nature documentaries available, however, thanks to the breathtaking and unprecedented footage. The series was shot during the coronavirus pandemic, and local camera operators from the various countries were hired due to travel restrictions. A sense of local pride and intimacy seems to come through with the footage, and the character-led stories are so rich and emotional that it is hard not to get invested in the drama.

Each of the four episodes is narrated by a different celebrity. Actors Rashida Jones, Rebel Wilson, Bryan Cranston and Pedro Pascal each bring their own personality to the table as they voice clips of big cats, dogs, marsupials and octopuses.

In the opening episode, Jones reveals the surprisingly caring, collaborative and resilient side of big cats. It is an aspect of their behaviour that has rarely been shown in such detail, which makes the series opener feel fresh and revelatory. The footage is utterly gorgeous and intimate throughout, from showing leopards stealing food from bins outside homes in the streets of Mumbai, India, at night to a snow leopard trying to kill an ibex on the edge of a cliff in the Himalayas. I found myself wondering aloud how they filmed many of the scenes.

This is especially true of *Animal*'s dramatic action sequences, the detail of which means that the first episode may not be suitable for all ages. That isn't to say that the scenes are explicitly gruesome or gory. They just don't shy away from showing just how powerful and deadly the likes of lions, tigers, cheetahs and leopards are when they hunt and kill.

The second episode, narrated by Cranston, moves from cats to dogs, focusing on their sharp senses, athleticism and fierce determination. Exploring the lives of African wild dogs, red foxes, grey foxes and other canines, it doesn't quite match up to the epic scope of its immediate predecessor. Even so, Cranston is a delightful guide, poetically leading us through dogs raising their young and scurrying for food in Botswana, Arizona, Canada and even on the suburban streets of Bristol in the UK.

Wilson narrates the third instalment, which was filmed in her native Australia and examines the lives of marsupials including kangaroos, Tasmanian devils and koalas. Wilson goes for a more comedic approach and, while the jokes don't always land, it is a refreshing shift in tone.

Then, for the fourth episode, the enigmatic Pascal (best known for his portrayal of the title character in *Star Wars* series *The Mandalorian*) dives deep into the oceans to provide an eye-catching glimpse of the cephalopod family. It is a spectacular reminder that octopuses may be the closest thing we have to alien intelligence on Earth, which helps to make it the most colourful and audacious episode of the four, as well as the perfect way to bring the series to a close.

We won't have too long to wait for further episodes, with more celebrity narrators and animals. Four more have been confirmed for 2022, with Andy Serkis, Anthony Mackie, David Harbour and Uzo Aduba focusing on bears, apes, dolphins and birds of prey.

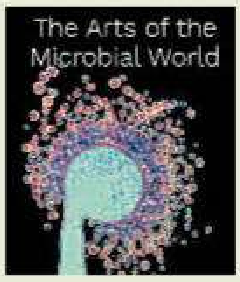
Overall, *Animal* does little to break the mould of the traditional nature documentary, but when the sequences are so sumptuously shot and the stories so immersive, it doesn't really matter. ▮

The sharp senses and athleticism of wolves are showcased in *Animal*

NETFLIX

Gregory Wakeman is a journalist based in Los Angeles

Don't miss

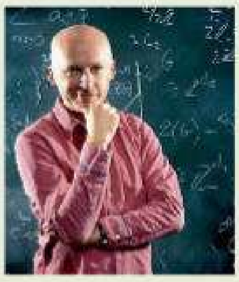


Read

The Arts of the Microbial World powered Japan's post-war rise, says science historian Victoria Lee, as traditional brewing and laboratory science combined to bring us everything from MSG to statins.

Watch

Lost in Space enters its third and final season from 1 December on Netflix. Maxwell Jenkins plays Will Robinson, a young boy who is on a mission to save his family from alien-made killer robots, deadly asteroid fields and other space dangers.



Watch

Marcus du Sautoy introduces *Thinking Better: The art of the shortcut*, his new book about what maths can tell us about human psychology. The free online talk will be at secondhome.io at 7pm GMT on 30 November.

BOTTOM: OXFORD UNIVERSITY IMAGES/JOBY SESSIONS

The sci-fi column

Rewriting the rules

A collection of stories by Charlie Jane Anders reveals the hidden forces that constrain our lives, and reminds us that we can choose whether or not we accept them, says **Sally Adee**

Sally Adee is a technology and science writer based in London. Follow her on Twitter @sally_adee

Book

Even Greater Mistakes

Charlie Jane Anders

Tor Books

Sally also recommends...

Books

Interlibrary Loan

Gene Wolfe

Tor Books

A rare original take on uploaded consciousness. What if some people's stored digital consciousness were lent out by libraries for various reasons? Like to solve a murder!

Exposure

Louis Greenberg

Titan

A science fiction/thriller set around a strange immersive theatre that may be something more, straight out of the Black Mirror *playbook.*

THAWEESAK SAENGNGOEN/GETTY IMAGES

Crack the laws of the universe and you can go and visit your future life

MANY years ago, after a physics class that introduced me to the idea of Dyson spheres and ringworlds, I plodded through the snowy streets to pick up a copy of Larry Niven's sci-fi classic, *Ringworld*. I barely made it halfway through the book before the brutally sexist portrayal of the only female character, a pneumatic bimbo named Teela, killed my enthusiasm. The book went in the bin.

On reflection, the most offensive thing about *Ringworld* wasn't the sexism, but the sea of unexamined assumptions sloshing around behind his characterisations.

Charlie Jane Anders didn't care for Niven's boob-fest either and now, 50 years later, she gets to unravel these assumptions from her spot at the pinnacle of a very changed sci-fi scene. With *Even Greater Mistakes,* she precisely unpicks what is behind the choices writers make available to their characters.

Anders has a heck of a pedigree. In the 2000s, she founded Gawker's sci-fi/science aspect, io9, and has since written several books and piles of short stories. This collection is a sampler of some of her favourites.

In *Love Might Be Too Strong a Word*, which can be read as a direct riposte to Niven, she shows us the mechanisms by which the biology of being female can be semiotically synonymous with a loss of power.

> **"Anders excels at revealing how hidden mechanisms shape our lives and at showing us their artifice"**

A generation starship is crewed by six different non-human species, whose bodies are wildly different from our own apart from in one detail: the reproductive biology of, well, giving and taking. The words man and woman are in the aliens' language, but instead of nouns, they are verbs that link the mechanics of sex to the roles that the individuals play on board. Who will "man" and who will "woman" is strictly regulated by the presence of an "innie" or "outie". "Pilots always man," a higher caste suitor explains to his would-be mate. "Dailys always woman. That's just how it is." And so biology becomes a de facto caste system.

In *The Time Travel Club*, the process by which we pick ourselves up after life has been devastated by our own choices is unspooled in a beautiful, haunting little tale. Coming to terms with consequences is depicted as a literal form of time travel: you must project yourself into a future to see if you still have one.

Introductory vignettes that accompany each story describe the key that unlocked the tale for Anders. For example, in the preamble to the time travel story, she describes consulting a physicist to learn the trigonometric equations needed to figure out how the rotation of Earth, its path around the sun, the galactic rotation and the expansion of the universe would each affect time travel into various points in the future. She does her homework, she doesn't just make this stuff up.

Anders excels at revealing how various hidden mechanisms shape our lives and at showing us their artifice. The gender architecture in *Love Might Be Too Strong a Word* isn't set by natural evolution: these creatures were genetically designed to live on the generation ship and to take its cargo to the next planet. The biological encoding of gender was a Trojan horse for a caste system.

But as Anders shows us, we have choices in how to deal with these rigged systems. We can always throw the whole lot in the bin. ▮

New Scientist Academy

USE CODE BLACK60

60% OFF NOW

This Black Friday
An offer to eclipse all others
60% off the first 500 courses booked
Don’t miss out

New Scientist Academy

Reassess your reality on our Secrets of Consciousness course

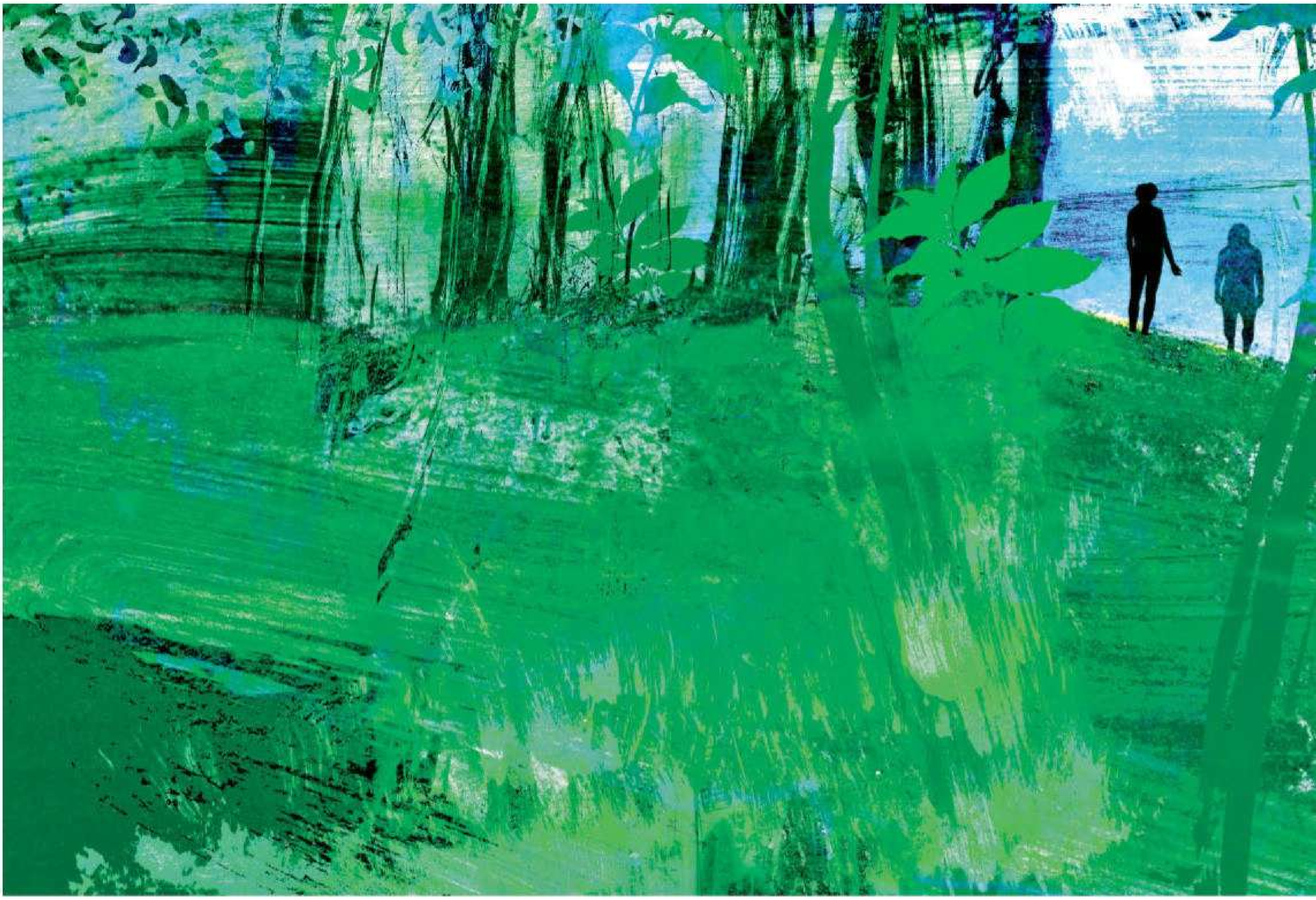
Consciousness

New Scientist Academy

Find the missing links in your understanding of evolution.

Evolution

Broaden your horizons and indulge your love of science this Black Friday. Book your online course now at **newscientist.com/academy**



SIMON PEMBERTON

The last human

Of all the other types of humans that existed, why are we the only ones left, asks **Kate Ravilious**

HUMANS today are uniquely alone. For the majority of the existence of *Homo sapiens*, we shared the planet with many other types of human. At the time when our lineage first evolved in Africa some 300,000 years ago, there were at least five others. And if you were going to place a bet on which of those would outlast all the rest, you might not have put your money on us.

The odds would have seemed more favourable for the Neanderthals, who had already adapted to live in colder conditions and expanded to inhabit much of Eurasia. Or *Homo erectus*, who had made a success of living in south-east Asia. By contrast, our direct *Homo sapiens* ancestors were the new kids on the block, and wouldn't successfully

settle outside of Africa until more than 200,000 years later. Yet, by 40,000 years ago, or possibly a bit more recently, we were the only humans left standing. Why?

Many explanations have been put forward: brainpower, language or just luck. Now, a new idea is building momentum to explain our dominance. Ironically, it may be some of our seemingly deepest vulnerabilities – being dependent on others, feeling compassion and experiencing empathy – that could have given us the edge.

Today, surrounded by computers, phones and all the other clever things we have invented, it is easy to pin our success on our cognitive abilities. But the more we learn about other types of human, the more they seem similar to us in this regard. In the case of Neanderthals, and possibly the mysterious Denisovans, this includes the ability to make sophisticated tools, such as projectile spears that enabled them to hunt large game. Similarly, we are discovering that artistic flair – a marker for the ability to think symbolically, and thought to be another vital ingredient for our dominance – wasn't just the preserve of our species. *Homo erectus* etched patterns onto shells some 500,000 years ago and Neanderthals drew on cave walls.

More recently, the focus has shifted from intelligence to our ability to network with strangers: the survival of the friendliest. Archaeological evidence shows, for example, that *Homo sapiens* not only lived in larger groups than all other humans, but had an unparalleled ability to form alliances beyond their immediate group. It might be that these social abilities helped to make us the most adaptable humans, the only ones capable of occupying every single biome on the planet.

Other humans certainly became adept at living in particular environments. *Homo heidelbergensis* and the Neanderthals, for example, had the cultural and technological skills – the ability to make clothing, fire and shelter – needed to branch out into colder climes. The diminutive newly discovered *Homo luzonensis*, along with *Homo floresiensis* (aka the hobbit), thrived in woodland environments. "But it is doubtful that these humans would have been successful if they were magically plopped down in the other's habitat, whereas *sapiens* likely could have," says Brian Stewart, an archaeologist at the University of Michigan.

Stewart, together with Patrick Roberts, an archaeologist at the Max Planck Institute for the Science of Human History in Jena, Germany, argues that our *Homo sapiens* ancestors set themselves apart by developing a new ecological niche, which they call the generalist specialist. "Not only could *Homo sapiens* generalise and expand across the world, but specific populations could also specialise in certain environments," says Roberts. "Together, this allowed our ancestors to thrive in the face of climatic and environmental variability."

However, it still isn't clear how we became the masters of adaptability. Now, Penny Spikins, an archaeologist at the University of York, UK, has a new explanation. She thinks that our emotional nature and frailties gave us the edge. "Our emotional neediness gave us the drive to connect with others," she says. And expanding our network made us more resilient, allowing us to flourish in many different environments.

To understand why, we have to turn the clock back around 2 million years to when these complex emotions appear to have emerged, and travel to southern Africa to meet our ape-like ancestor *Australopithecus*. Here, we find the earliest known examples of the possible care for sick or injured hominins, with evidence from the skeletons of individuals who lived with bone problems that would have caused pain and disability, such as a teenage boy with a spinal tumour. "They almost certainly received some level of help, being given food and protection, to survive with these conditions," says Spikins, whose book exploring these ideas, *Hidden Depths: The origins of human connection*, will be published next year.

Care in the community

Examples in the archaeological record of caring for fellow hominins increase over time and are commonplace by the time Neanderthal communities emerge. One Neanderthal skeleton found in Shanidar cave in Iraq and dated to about 50,000 years ago shows signs of multiple severe injuries, including the loss of the right forearm and hand. But remarkably, this individual survived for 10 to 15 years after his accident, and was carefully buried when he died aged between 40 and 50. "His care must have been extensive," says Spikins.

This investment in caring brought benefits for the group as well as the individual. "It allowed humans to hunt dangerous animals whilst living with the consequences in terms of injury risks. And it also allowed longer lifespans, enabling grandparents to be involved in infant care, as well as passing on knowledge and skills," she says.

Archaeological evidence of those benefits becomes increasingly apparent as we get closer to the present day, showing humans hunting animals larger than themselves and working together to tackle particularly dangerous beasts, such as woolly rhinoceros, mammoths and giant Cape buffalo.

But when *Homo sapiens* emerged, they took these collaborative skills one step further and began to extensively interact with others outside their own immediate group – ›

New Scientist audio
You can now listen to many articles – look for the headhones icon in our app **newscientist.com/app**

something not seen before. Exactly what drove this is unclear, but large swings in climate in Africa would have made life difficult, and those who collaborated may have been more likely to survive. Around 320,000 years ago, in the Olorgesailie basin in what is now southern Kenya, people began to transfer obsidian – a highly valued volcanic glass used for spear points – over longer distances, up to 90 kilometres in some cases. This suggests that interactions were occurring with neighbouring groups. Over time, these long-distance networks expanded. By 30,000 years ago, Stewart and his colleagues have shown that *Homo sapiens* in southern Africa were exchanging ostrich eggshell beads over distances of more than 300 kilometres.

This expansion of our social networks was a significant part of our success, says Chris Stringer at the Natural History Museum, London. "Interacting with more people allowed us to acquire behaviours and inventions from neighbouring groups, which may have aided survival." By contrast, the Neanderthal's apparently insular way of life may have cost them dear. Ten wooden throwing spears, excavated from a mine in Schöningen, near Hannover in Germany, and dated to around 300,000 years ago, would have enabled those who used them – perhaps early Neanderthals – to hunt big game from a distance. "You would assume that such a good invention could never be lost, but maybe within 10,000 years of the Schöningen people living there, the entire area was covered by an ice sheet and all these humans were gone," says Stringer. "If these people weren't part of a much wider social network then the technology that was special to their group would have died with them."

> **"If things had turned out differently, would it be Neanderthals' ancestors here today?"**

Not only did such networks allow *Homo sapiens* to pass knowledge on, but they were an insurance policy for when times are bad. "If a drastic climate change occurred, then some populations might struggle, but others living in a different region might thrive, and may have been able to help out their neighbours. This would have allowed us to become incredibly resilient," says Roberts.

He and his colleagues have found evidence for this kind of supporting collaboration in the dense jungle environments of south Asia, some 50,000 years ago, when *Homo sapiens* first settled this region. These pioneers spread across this challenging environment with unprecedented speed. The isotope chemistry of bones found deep within the jungles of Sri Lanka reveal that *Homo sapiens* inhabited the rainforest all year round. "They became rainforest specialists, using bow and arrow to hunt monkeys and giant squirrels," says Roberts. But artefacts found alongside their bones, such as marine shell beads and sharks' teeth, indicate that they also had contact with populations from coastal regions. "What you end up with is a beautiful picture of two different populations – one in the forest and one on the coast – and they are communicating," says Roberts.

The more we look, the more we see evidence for increased social interaction and wider networks when *Homo sapiens* first emerge. But

The others

Many other types of human existed at the same time as us. The best known are outlined below, but there are likely to be more, as yet undiscovered.

Homo erectus

The first of our ancestors to develop shorter arms and longer legs, and to expand beyond Africa ~1.8 million years ago (ya)
When: 1.89 million to 110,000 ya
Where: Africa, western and eastern Asia, perhaps Europe

Homo heidelbergensis

The first humans to live in colder climates and routinely hunt large animals. Thought to have eventually evolved into *Homo neanderthalensis* in Europe and *Homo sapiens* in Africa
When: 700,000 to 200,000 ya
Where: Eastern and southern Africa, Europe and possibly Asia

Homo neanderthalensis

(Neanderthal)

Shorter and stockier than us, with a protruding brow ridge and brains as large as ours, if not larger
When: 400,000 to 40,000 ya
Where: Europe, south-western to central Asia

Denisovan

(no formal species name due to lack of fossil material)

Identified in 2010 from DNA in a finger bone found in Siberia. Denisovan populations overlapped and interbred with Neanderthals and *Homo sapiens*
When: Highly uncertain – at least 300,000 ya to as recent as 15,000 ya
Where: East Asia

Homo naledi

Discovered in 2013. Displays a mix of ancient and modern human features (small brain, very long fingers but modern human-like hands and feet). Its anatomy suggests it walked on two legs, but could climb and hang from trees.
When: 335,000 to 235,000 ya
Where: South Africa

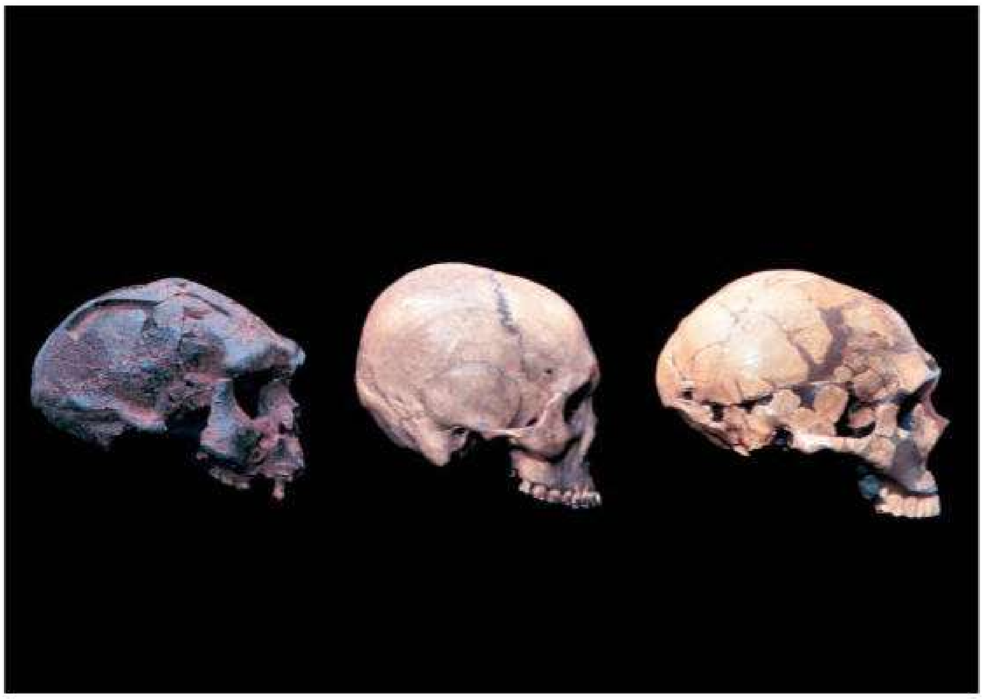
Homo luzonensis

First identified in 2019 from a few bones, this diminutive human has a blend of ancient and modern features, hinting that it might have been a descendant of an early pre-*Homo erectus* dispersal out of Africa.
When: ? to 50,000 ya
Where: The island of Luzon in the Philippines

Homo floresiensis

(nickname: the hobbit people)

Discovered in 2003, these small yet capable people, with tiny brains, large teeth, no chin and a receding forehead, used stone tools, hunted small elephants and may have used fire. Their diminutive stature might have been a form of island dwarfism, or it could reflect a shared ancestry with *Homo luzonensis*, from an early wave of small humans that ventured into Asia.
When: 190,000 to 50,000 ya
Where: Flores island, Indonesia



NATURAL HISTORY MUSEUM, LONDON/SCIENCE PHOTO LIBRARY

Compared with *Homo erectus* (left) and *Homo Neanderthalensis* (right), *Homo sapiens* (centre) has more delicate facial features

what gave us the courage to interact with our neighbours in a way not seen in other human lineages? Genomic analysis of a rare genetic condition known as Williams syndrome has recently shed light on this question.

People with Williams syndrome are often hyper-social – trusting and happy to hug strangers. The condition is also associated with a range of health risks, including heart issues, and a distinct physical appearance, including delicate facial features such as smaller teeth.

The syndrome is caused by small deletions of genetic material, of which one gene – *BAZ1B* – has been the subject of much research during the past decade. This gene is associated with the control of neural crest cells, which form the basis for many tissues during embryonic development and create the adrenal glands that influence our hormonal response to stressful events. The absence of this gene results in reduced migration of the cells, providing an explanation for the delicate facial features and health issues associated with Williams syndrome, as well as the reduced levels of fear, leading to hyper-social behaviour.

The genetic changes associated with Williams syndrome caught the attention of Cedric Boeckx at the Catalan Institution for Research and Advanced Studies in Barcelona, Spain. He wondered if they could help explain why our *Homo sapiens* ancestors started to expand their social networks in the past. Working with Giuseppe Testa at the University of Milan, Italy, the researchers compared the modern human genome with that of our closest relatives, the Neanderthals and Denisovans, and found that *BAZ1B* had undergone many more mutations in *Homo sapiens*, suggesting strong evolutionary selection pressure for traits associated with this gene. "It gives us a handle on the direction of genetic change that may have made us more tolerant of strangers," says Boeckx.

What's more, the same mutations may explain why Neanderthals are sometimes described as looking brutish, with their heavy brow ridges and robust jawline. "As well as making us less aggressive, these genetic changes seem to result in physical features that make us appear less threatening," says Spikins.

Essentially, it seems that our *Homo sapiens* ancestors "domesticated" themselves. Archaeological finds confirm that the softening of our facial features, with the development of smaller skulls, flatter faces and tinier teeth, starts to occur in our lineage around 300,000 years ago.

The question then becomes what effect these changes had. To find out, scientists have looked at other species that have also undergone similar genetic changes and evolved in the "friendly" direction, such as bonobos – a highly social ape – and animals that have been deliberately domesticated, including dogs, sheep and cows.

Compared with chimpanzees, which haven't undergone self-domestication, bonobos are less scared of strangers and more willing to share and interact in a positive way with others at the borders of their territory. Similarly, dogs are more tolerant than wolves of living in a group with unrelated animals, and dogs have evolved flatter faces that are capable of more expression. "Being expressive enables greater communication and makes you less threatening," says Spikins.

> **"Our emotional neediness may have been our trump card during climate changes"**

In the case of *Homo sapiens*, it appears that we took expressiveness to another level, with the development of language. "It seems likely that language helped us to maintain our social networks and was one of the skills that enabled us to adapt to lots of different environments," says Boeckx.

There are, however, downsides to the social traits acquired during our long-running process of self-domestication. "Becoming more connected and tolerant towards other people gave us greater strength as a community, but our underlying drive to please others and belong to a group also makes individuals vulnerable to being lonely, depressed and anxious," says Spikins.

By 50,000 years ago, *Homo sapiens* had become well established across Eurasia, having finally burst successfully out of Africa. Then, between 50,000 and 40,000 years ago, there seems to have been a crunch, from which the Neanderthals and Denisovans were never able to recover. There was an intense cooling of the climate and a major volcanic eruption in Italy around 39,000 years ago, and a reversal of Earth's magnetic field around 42,000 years ago, which together are thought to have caused major climate changes around the world.

It is possible that our emotional neediness was our trump card during this difficult period. "Our drive to connect with others may have helped us to network more widely and cope better with the immense environmental changes at that time," says Spikins. Luck certainly played a part too. Perhaps our emotional skills just happened to be the best tool to navigate this particular challenge. Had the environment been different, it might have been other types of human that were better equipped to cope. "If things had turned out differently, for example with a more stable climate, would it be Neanderthals' ancestors here today?" says Spikins.

As Boeckx says: "The history of humans is full of fits and starts, and we are just looking at a snapshot of the last time we got lucky." ∎

Kate Ravilious is a freelance science writer in York, UK. Follow her @katerav

The weirdest volcano

ULRICH DOERING/ALAMY

Clues to some of Earth's deepest secrets may be hiding in the lava of Tanzania's Ol Doinyo Lengai. **Robin George Andrews** investigates

BLACK LAVA isn't what any reasonable person would expect to find inside their cocktail shaker. But when you are holding it, dangling over the edge of a crater in Tanzania, trying to study the world's strangest volcano, it is exactly what you want to see.

Stealing lava isn't usually so tricky. Sure, it is often many hundreds of degrees hotter than boiling water – not the kind of thing to dip your fingers into. But, armed with a decent shovel, you can dig into a lava flow and chuck some into a bucket of water, preserving its geological marvels. "Scooping it up is the easy bit," says Kate Laxton, a doctoral student of volcanology at University College London. Until, that is, the lava is 23 storeys below you, at the bottom of a steep crater.

That crater belongs to Ol Doinyo Lengai, the only volcano in the solar system known to still erupt carbonatite lava, which has some odd properties. But there is more to Ol Doinyo Lengai than its uniqueness. The black lava it bleeds gives us a window into an otherwise inaccessible bit of our world.

Earth's mantle is the hot, solid but plasticky part that makes up 84 per cent of our planet's volume. It cooks up eruptive matter and moves the surface world to make mountain ranges, ocean basins and continents, and deliver the occasional volcanic cataclysm. Yet we know surprisingly little about it, from how it gobbles up dying tectonic plates to the origins of its furiously hot matter. Ol Doinyo Lengai's black lava gives us a chance to find answers, but collecting it isn't easy.

To refer to this volcano as atypical would be an understatement. The lava you and I – and most volcanologists – are familiar with comes in beautiful hues of yellow, burnt orange, amber and eye-popping vermilion. But if you clamber up Ol Doinyo Lengai's steep summit, about 3 kilometres above sea level, and peer into its active crater, you will see the volcanic equivalent of a Rorschach test. Black fluids will fly into the air and splash across the crater floor, quickly cooling, mingling with the atmosphere and turning a silvery white.

Within the volcano's ghostly active crater, you can find shadow-hued cones called hornitos. Sometimes 15 metres high, they squirt out grey, brown, beige and black lava in all directions from their multitude of tubes and holes. The reason for these differing colours is unknown, but this lava has other

Black carbonatite lava makes the Ol Doinyo Lengai volcano unique

quirks aside from its colour. Molten rock can move at a range of speeds, but on a flat surface, you can generally walk faster than typical lava flows. Not so with Ol Doinyo Lengai's black lava, which is more fluid than water, moving hurriedly as if late for an appointment.

The reason for its unusual haste is what black lava contains. Most magma – the hot liquid rock found inside volcanoes – holds a fair amount of silica, a combination of one silicon atom and two oxygen atoms. Silica likes joining up into long chains that form a sort of skeleton for lava – magma that has been expelled from a volcano. The more extensive these chains are, the gloopier and more tar-like the lava is. Ol Doinyo Lengai's black lava is a carbonatite, which contains – among other things – a lot of calcium carbonate, the chalky stuff that builds up around your water tap, and sodium, but little silica. This means it lacks the skeletal strength of most other lavas, allowing it to flow absurdly quickly – fast enough, in fact, to occasionally catch up to an unlucky gazelle zooming down the volcano's slopes.

It is freakishly cool, too. The basaltic lava shooting out of the Cumbre Vieja volcano on the Atlantic island of La Palma, for example, is around 1000°C. But black lava, fresh out of the pit, erupts at 500°C, a mere five times hotter than the water boiling in your kettle. At times, it cools so quickly that it freezes in mid-air, creating cascades seemingly stuck in time.

The reason this volcano is so unconventional is the same reason that volcanologists are so keen to collect samples of its lava – carbon from Earth's mantle. A 2020 study, led by James Muirhead at the University of Auckland in New Zealand, used an array of evidence to conjure up the volcano's origin story. They found that the unusual long-term presence of mantle upwellings – superheated fountains that cook the base of tectonic plates, creating magma – have provided the volcano with an excess of carbon, allowing carbonatite magma to form. And a hefty supply of sodium from the deep, which bonds with the carbonatite, allows it to gush out as a lava. Without that crucial element, the carbonatite would break down and get belched out as carbon dioxide.

> **"To understand the habitability of our own world, we'd best not forget the mantle"**

This bizarre chemistry means that getting samples of Ol Doinyo Lengai's lava opens a window into a vast portion of the world that usually remains unreachable. It may be far below your feet, but "the mantle matters", says Paul Byrne, a planetary scientist at Washington University in St. Louis, Missouri. "It's the single largest continuous structure on – well, in – Earth. It's where at least half the heat from the interior comes from and where much of the volcanic material that shapes the surface originates." And yet the finer details of its shape-shifting anatomy, including superheated plumes that can open oceans and tear continents apart, remain elusive. "If we're to fully understand the geological character, evolution and even habitability of our own world, much less those properties of other planets, then we'd best not forget the mantle," he says.

Aside from a handful of shards originating deep in the mantle that get coughed out of certain volcanic eruptions, and some incredibly rare spots on the surface where bits of ancient mantle have been exhumed by tectonic forces, this realm is impervious to human eyes and hands. Seismometers offer clues as to what it is like, because seismic waves from earthquakes can plunge into and ascend out of the mantle. But these signatures provide nothing unequivocal. Fortunately, samples of black lava can give us some concrete information about this mystifying swathe of Earth's innards.

The first samples were collected in the 1960s. In 1983 the volcano entered an eruptive phase, which filled the crater with solidified lava, and a few more were collected. But an explosion in 2007 blasted it all away, leaving behind an incredibly steep wall. Now, the lava sits below a daunting drop of nearly 100 metres. No samples were gathered for 12 years, since it had stopped erupting, until Laxton tried in 2019.

Abseiling down would be too dangerous. A drone might be able to fly down and take a sample, but the wind at the summit is so strong that the drone could be blown into the crater and lost. "Technology always seems to crap out in front of me," says Laxton. As a climber, she suspected there was a way to use a system of pulleys and ropes to safely reach the lava, but she would need the help of a pro.

›

Not long before her expedition, Laxton spotted someone dangling from a large building near her university’s campus in London. He turned out to be experienced climber Arno Van Zyl. They had coffee, she explained her mission, and by the end of it, they were planning their trip to Tanzania. With them came Emma Liu, a volcanologist at University College London, several seasoned Ol Doinyo Lengai climbers, and a team of Tanzanian porters bringing food and water. The heist was on.

Ol Doinyo Lengai’s arcane chemistry – first revealed through sampling efforts in the 1960s – has long suggested to observers that something otherworldly was going on far below the surface. Hints as to the source of this unusual alchemy can be found in the volcano’s vast neighbourhood. It is in a part of East Africa that is slowly but surely being torn asunder by titanic tectonic forces, sitting on a fissure that stretches thousands of kilometres from the Red Sea to Mozambique.

Here, the African tectonic plate is roughly split into two smaller plates: the Nubian plate to the north-west and the Somalian plate to the south-east. Both are moving in opposite directions. Known as the East African Rift, this is where East Africa is breaking apart by a few centimetres every decade. When this kind of rifting occurs, Earth’s crust thins out, and the planet’s mysterious mantle gets remarkably close to the skin of the world. That can unleash some exotic chemistry and produce bizarre volcanoes – including Ol Doinyo Lengai, the most extreme of outliers.

Once at the summit, it was time to deploy Laxton’scooping devices. It turns out there is nothing better to hold samples of black lava than stainless-steel cocktail shakers and wine measures that refuse to melt in molten rock.

Laxton and her team set up anchor points around the circumference of the crater rim. They linked two of them, creating a tightrope-like pulley system spanning the crater. After the first containers plunged into the lava, disaster struck. Laxton yanked on the pulley too vigorously, causing the rope to break and the cups to fall into the lava.

A steep crater makes it tricky to collect the black lava that sits at the heart of Ol Doinyo Lengai

KATE LAXTON/UNIVERSITY COLLEGE LONDON

Geological jerky

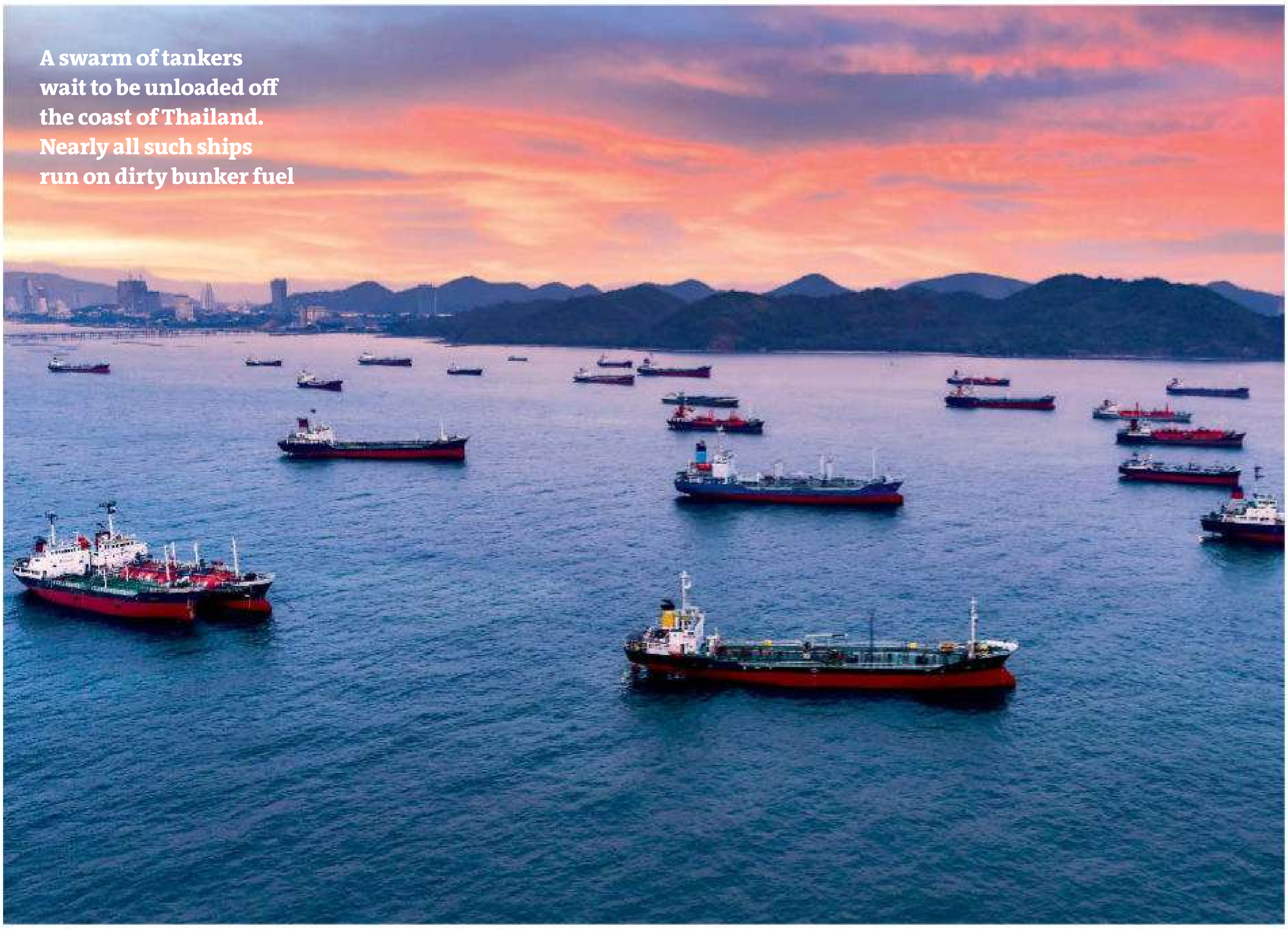
Thankfully, this was Laxton’s only scoop failure. The team watched as six scoops containing fresh samples of black lava rose up in turn, air-dried like slices of geological jerky, preserving their minerals and textures.

Those lumpy strips of frozen lava are still undergoing careful analysis, so it is too early to know what they may reveal about the volcano and its enigmatic plumbing. But Laxton and her colleagues hope to use them to decode the volcano’s eruptive cycle. Its crater fills with lava over the course of several years before the summit is rocked by a huge explosion that ejects these molten contents, and then the slow eruption of black lava begins anew. The chemistry of the volcano’s lava, which has been sampled by various teams at different points during this cycle, should help explain why Ol Doinyo Lengai dramatically switches between calm effusion and explosive anger.

The mission to understand this volcano goes deeper. The sorts of samples of lava obtained by scientists like Laxton contain vital clues to the planet’s underworld. Chemical signatures can not only reveal where in the mantle the ingredients for this strange magma originally came from, but also a bit about the cooking process. Did those ingredients shoot straight up into the volcano, or did they get mixed with other matter in the crust? The answers will tell us why the volcano erupts in the way it does.

Now, we are closer to finding them. Partly thanks to our predilection for alcoholic beverages, but largely down to the ingenuity of Laxton and her team, valuable new samples of the rarest of volcanic matter have been obtained. It is a step forward for volcanologists hoping to decode the mantle magic that makes the most eccentric volcano known to science. ■

Robin George Andrews is a freelance writer and author of *Super Volcanoes: What they reveal about Earth and the worlds beyond*



A swarm of tankers wait to be unloaded off the coast of Thailand. Nearly all such ships run on dirty bunker fuel

SURIYAPONG THONGSAWANG/GETTY IMAGES

Swabbing the decks

The shipping industry is essential to global trade – but incredibly polluting. **Nicola Jones** investigates what it will take to clean it up

IN FEBRUARY 1925, a strange kind of ship put out from the wharves of Kiel, Germany, onto the cold Baltic Sea. It sliced through the water, with two towers resembling giant smokestacks rising from its deck. But according to accounts from the time, no smoke was to be seen and no engine noise could be heard.

This could have been the start of a new age of shipping. Created by German engineer Anton Flettner, those towers were clever devices that harnessed the power of the wind better than any piece of cloth. They worked well – but alas, they didn't catch on. The designs languished in dusty bottom drawers for nearly a century, as ships relied instead on cheap fossil fuels to ply the oceans.

That reliance on fossil fuels has become a huge problem. Shipping is a vast industry that underpins the global economy, helping to deliver all manner of goods, from food to fridges to fidget spinners. Yet it is a horror to the environment, with vessels burning

›

dirty fuel and spewing vast amounts of greenhouse gases.

Now, shipping is beginning to grapple with its climate conscience and serious efforts are under way to cut those emissions. Inventions like Flettner's could be part of the solution, along with sleeker vessels, smarter navigation and greener fuels. There are choppy waters ahead, to be sure, but the technology we need to make our sea transport environmentally shipshape is on the horizon. "We're steering towards zero-emission transport," says Hélène Smidt at the Royal Belgian Shipowners' Association.

Shipping has come a long way since 1925, not least thanks to the invention of the shipping container in the middle of the 20th century. This standardised and industrialised ocean transport, helping it grow to epic proportions. Add in oil tankers, tugs, ferries, bulk carriers that bear minerals and ores – and all the rest of the world's vessels – and there are more than 110,000 large ships on the oceans today. Some have grown to colossal sizes. The Ever Given, the container ship that blocked the Suez Canal in March, is longer than the Eiffel Tower is tall – and it isn't even the biggest ship out there.

All those ships collectively emit more than 1 billion tonnes of greenhouse gases every year, with container ship traffic the worst offender (see "Dirty ships", page 48). Together, the industry is responsible for almost 3 per cent of global emissions, roughly the same as aviation. Shipping is so dirty in part because it relies on bunker oil, a fossil fuel with the consistency of tar, rife with sulphur and nitrogen compounds that turn into pollutants when burned. "It's the sludge left at the bottom of the barrel after you've refined everything else," says Gavin Allwright, head of the International Windship Association. "It's toxic waste."

110,700

Number of ships weighing more than 100 gross tonnes

553

Number of ships using sources of power other than bunker oil, mostly batteries or liquid natural gas

SOURCES: DNV MARITIME FORECAST TO 2050, ENERGY TRANSITION OUTLOOK 2021

Blame game

Until recently, the problem of shipping emissions had been shoved aside. One reason for this is disagreement over who is responsible for them: the country that sold the fuel, the country where the ship is registered or the country shipping or receiving the goods.

That neglect is starting to lift. In 2018, the UN's International Maritime Organization (IMO), which can set mandatory rules for the shipping industry, put in place the goal of reducing every ship's carbon intensity – that is, the emissions per weight per distance travelled – by at least 40 per cent compared with 2008 levels by 2030. In June 2021, it introduced new rules for compliance with specific measures of efficiency and carbon intensity that ships will need to meet by 2023.

The trouble is that ocean traffic is expected to keep going up. This means that even a significant lowering of all ships' carbon emissions could be overshadowed by the sheer number of new vessels belching carbon as they make more trips. For this reason, the IMO has also set the goal of cutting total greenhouse gas emissions from the shipping industry by 50 per cent by 2050 – though the mechanisms to make this happen are still being thrashed out. These targets could soon get even more stringent: the emissions rules are due for revision in 2023 and Roel Hoenders, head of the IMO's air pollution and energy efficiency efforts, says this will "very likely contain more ambitious and more far-reaching goals".

One way to meet the immediate goals would be to stop shipping so much stuff around the planet. Some forecasts do anticipate the size of the global maritime fleet levelling off by 2050, mainly thanks to a reduction in tankers, even as shipping container numbers continue to rise. But for now, traffic is soaring. While there was a downward blip during the early months of the pandemic, it has rebounded in force. A 2019 analysis led by Anthony Sardain, then at McGill University in Canada, projected that, by 2050, maritime traffic will increase by between 2 and 12 times compared with 2014 levels.

SHUTTERSTOCK/AMAZING AERIAL PREMIUM

"Chugging along at half speed provides a hefty two-thirds reduction in fuel requirements"

The good news is that the IMO's 2030 target can be largely achieved by ramping up relatively simple efficiency measures that are already under way. These include things like giving ships a "nose job" to make the prow more hydrodynamic, applying special low-friction coatings or blowing bubbles under the hull to lubricate passage. It could also include simply packing more containers onto ships, travelling only when full and rerouting to avoid bad weather. Perhaps the most

Container ships load at Réunion, an island in the Indian Ocean

important trick is the simplest of all: chugging along at half speed provides a hefty two-thirds reduction in fuel requirements. Maersk, the world's largest shipping container operator, with more than 700 vessels, says it has already sliced its carbon intensity by about 46 per cent since 2008 using such measures. Many other large shipping firms are taking the same tack: the IMO estimates that, by 2018, the industry's average carbon intensity had already been cut by at least 20 per cent.

The 2050 target of reducing total emissions from shipping by 50 per cent will be much harder to hit. Given that maritime trade has already gone up more than a third since 2008, along with projected increases in ship traffic, this will require reducing the average ship's carbon intensity by more than 80 per cent, says engineer Tristan Smith at University College London. Achieving that will require both swapping bunker fuel for lower-carbon alternatives and figuring out ways to use a heck of a lot less of it (see "Every little helps", page 48).

When it comes to low-carbon fuel, electric batteries and fuel cells will be part of the solution, creating peaceful rides without the smells and vibrations of a fuel-powered ›

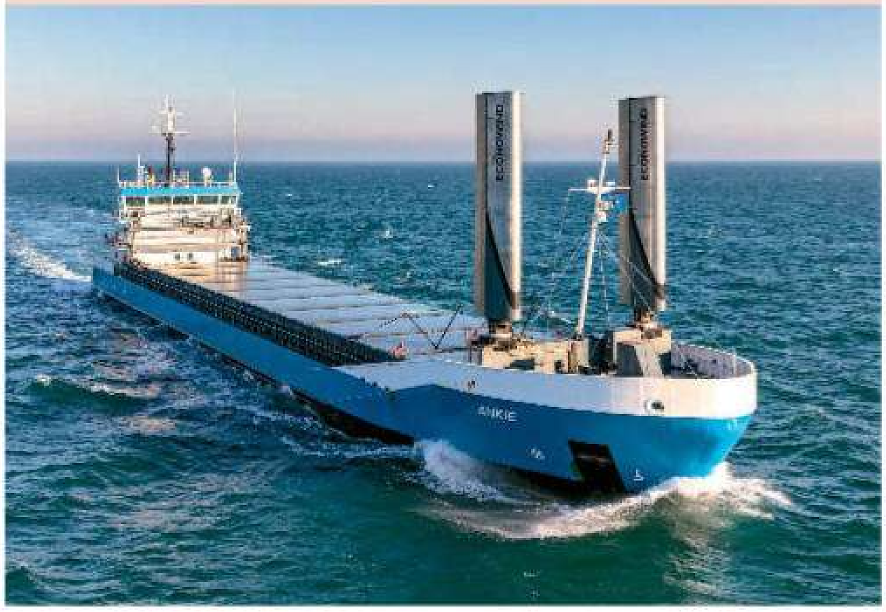
Water wings

French explorer and ocean researcher Jacques Cousteau was taken with the idea of using tall poles to harness the wind and power ships (see main story). In the 1980s, he set out to design his own. He ended up with a device he called the turbosail. It is essentially a hollow aircraft wing erected vertically on the deck of a ship, with flaps that can open and close. A motorised fan sucks air out from inside the turbosail, and air flows over its surface, creating thrust in a similar way to how a wing produces lift on an aeroplane.

Cousteau's idea never went mainstream. But now Econowind, a company based in the Netherlands, is pursuing the concept with its modern turbosails called Ventifoils. The company has done two installations since launching two years ago, and has a portable container that it rents out, which can be installed on a container ship to give it instant, pop-up Ventifoils. Econowind says this produced between 7 and 11 per cent fuel savings on a trial run in 2019.

Innovators are also playing with hulls that are themselves shaped like aeroplane wings, and with souped-up versions of simple technologies like kites. This year, Airseas, a spin-off from engineering company Airbus, is installing a 500-square-metre SeaWing kite on a cargo ferry called the Ville de Bordeaux. The company predicts it will lead to a 20 per cent improvement in fuel economy, with an AI-powered system helping steer the kite to harness every puff of wind.

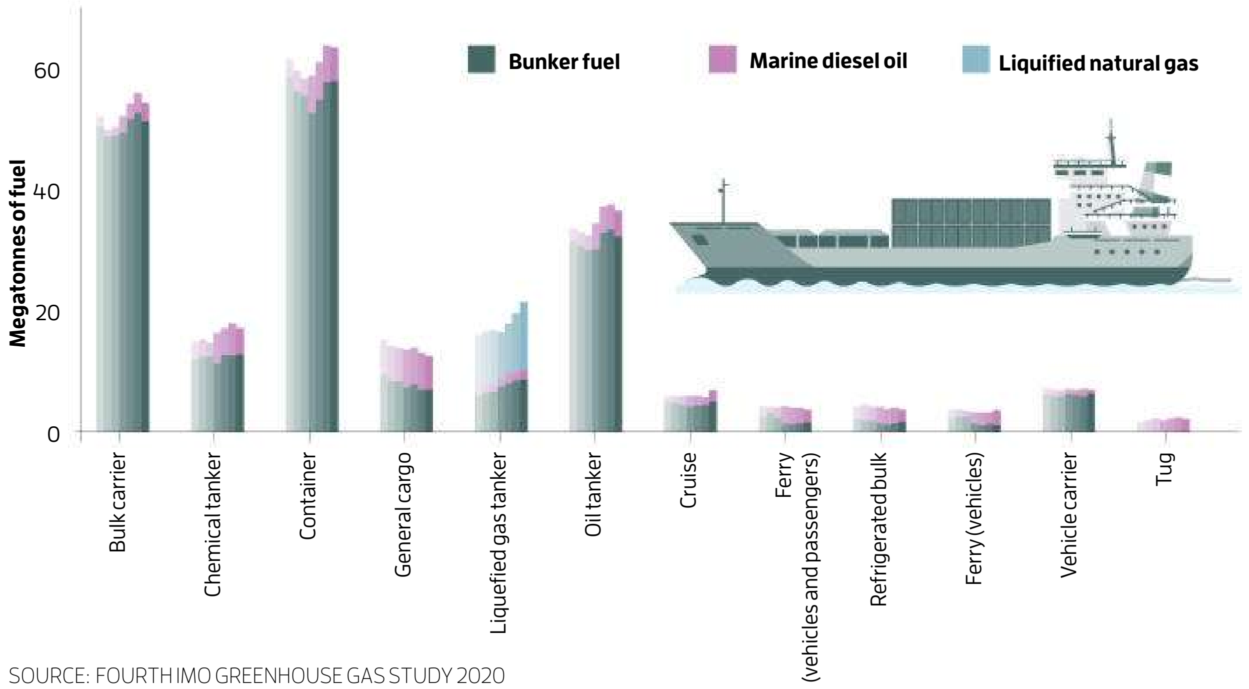
"Ventifoils" capture the power of the wind and can help reduce ships' fuel needs



COURTESY OF ECONOWIND

Dirty ships

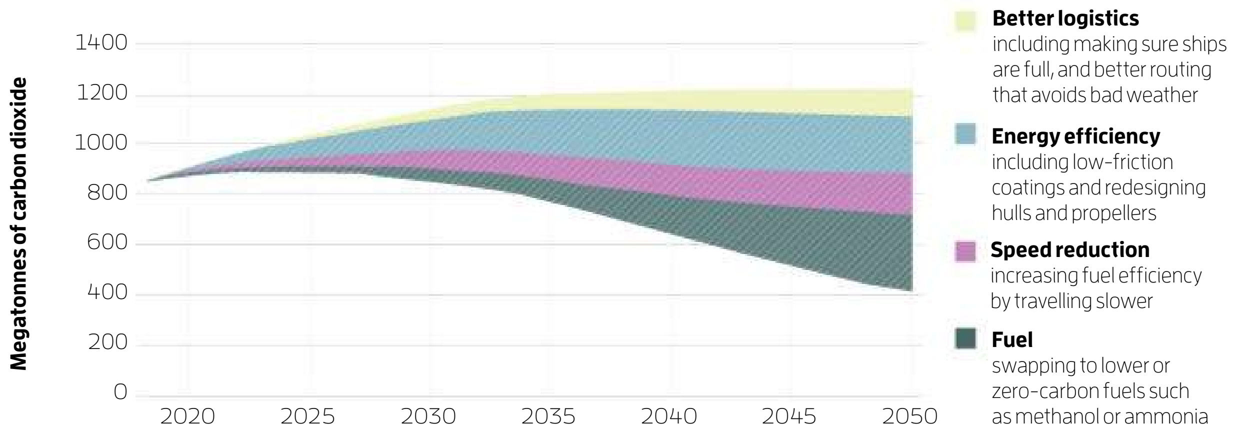
Most ships run on bunker oil, which creates a lot of pollution when burned. But as the figures from 2012 to 2018 show, cleaner fuels are slowly entering the mix



SOURCE: FOURTH IMO GREENHOUSE GAS STUDY 2020

Every little helps

Projections show how shipping emissions can be cut significantly through a range of measures, including using less-polluting fuel, reducing the speed of vessels and improving logistics



SOURCE: DNV

vessel. "You don't actually feel that you're on a ship," says Hoenders. But these solutions take up a lot of space for the power they produce. "If we wanted to actually propel a container ship just with batteries, we'd have no room left for cargo," says Lee Kindberg, Maersk's head of environment and sustainability.

One of the few technologically mature alternative fuels that has the oomph for international shipping is liquefied natural gas or LNG. This burns cleaner than bunker fuel, producing about a quarter less carbon dioxide and has been touted as a bridge fuel to get the shipping industry to lower emissions. Its use went up by about 26 per cent between 2012 and 2018. The trouble is that LNG consists mainly of methane – an extremely potent, if short-lived greenhouse gas – which tends to leak out of pipes and engines. This may make using LNG entirely counterproductive.

Maersk is avoiding LNG because of precisely this problem, says Kindberg. Instead, it is replacing up to 30 per cent of some of its ships' bunker fuel with biofuels made from used cooking fat. This cuts emissions from a small number of vessels, allowing the firm to charge a premium for zero-carbon shipping for a fraction of the cargo. Some other large shipping firms, such as Mediterranean Shipping Company, have taken similar action.

While the emissions savings are real, Smith says the cooking fat strategy is a "disingenuous quick fix". This is because there just isn't enough biofuel around for it to act as a large-scale solution. He gives Maersk more credit for commissioning eight new ships designed to run on green methanol, a carbon-based fuel similar to alcohol, which will be made in plants powered by clean electricity.

Fuel of the future?

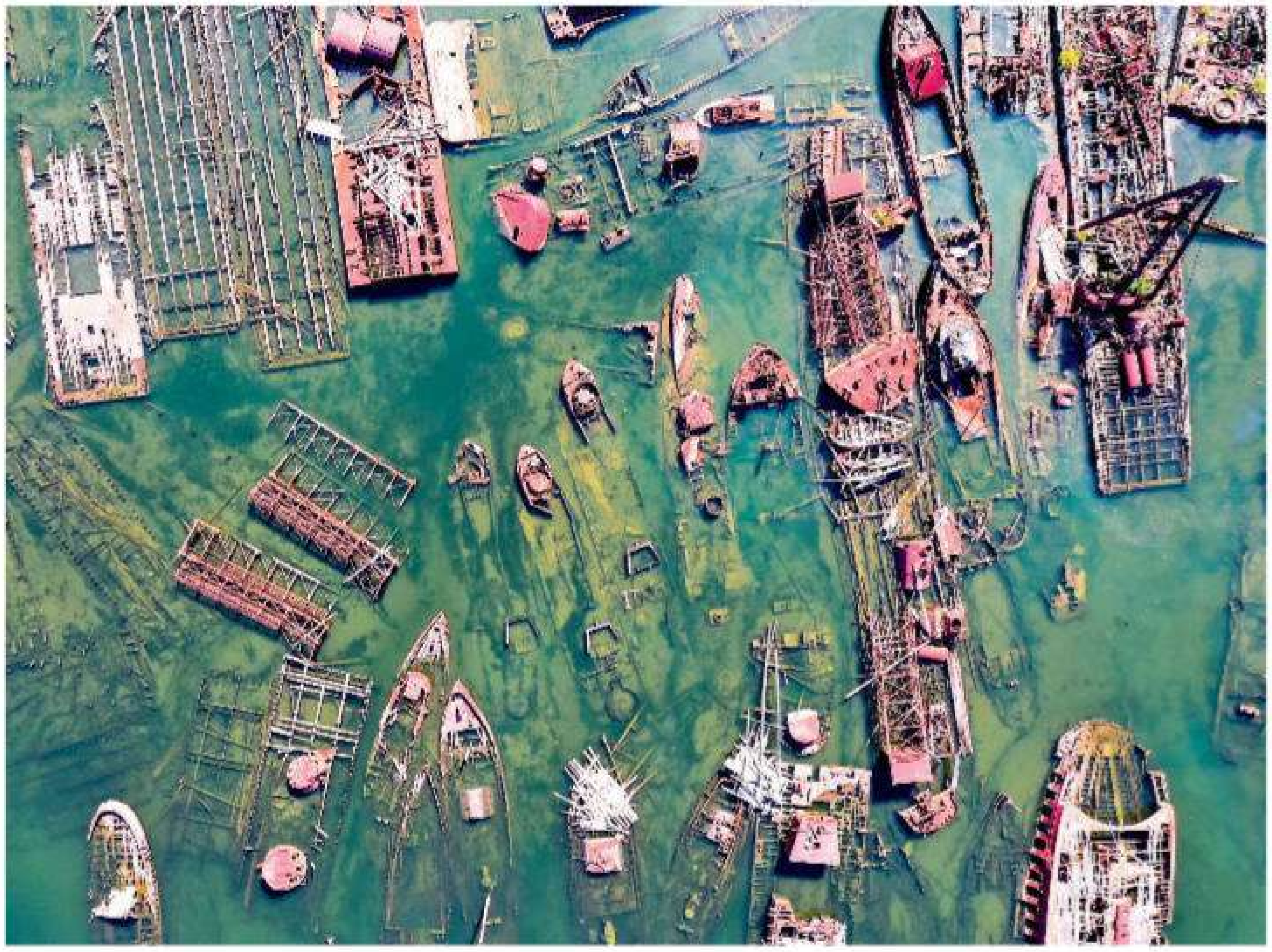
In the longer term, maybe a decade from now, many shipping firms are betting on ammonia as the fuel of the future. Ammonia, composed of nitrogen and hydrogen atoms, produces no CO_2 when burned. It is similar in that respect to hydrogen, which is often considered as a future green fuel. But ammonia has twice the energy per volume and can also be used in either a combustion engine or a fuel cell.

"Ammonia is very promising as a fuel for the bigger ships," says Smidt. But there are still hurdles. Ammonia is toxic, so hauling it around can be dangerous. And, while it doesn't produce CO_2, burning it does generate nitrogen dioxide, which makes smog, and nitrous oxide, which is itself a potent greenhouse gas. Ships will need systems to limit or scrub those emissions.

The bigger difficulty is making enough ammonia in a green fashion. Right now, the world produces about 150 million tonnes of the stuff a year, mainly for agricultural fertiliser, through an energy-hungry process that has a gigantic carbon footprint. "We will need 400 to 500 million tonnes of ammonia to feed shipping," says Smith – and it needs to be made without using fossil fuels for energy. This is a huge – but achievable – task, says Smith. For now, however, there are only a handful of such projects afoot.

According to a 2021 report by consultancy DNV, only 0.5 per cent of the global shipping fleet is currently running on alternative sources of power, mostly batteries and LNG. Things are changing though: 12 per cent of new ships on order have alternative fuel systems, which is double the percentage from the firm's 2019 assessment. Alternative fuels will need to feed at least 60 per cent of the global fleet by 2050.

Moving that fast will require some serious incentives, says Smith. Hoenders revealed to *New Scientist* that the IMO is working on measures now. "It is very likely there that the IMO will put in place a market-based



Ships slowly rot in a boat graveyard off Staten Island, New York

FELIX LIPOV/SHUTTERSTOCK

measure in the coming years," he says, perhaps a cap-and-trade system. "We need a carbon price for shipping," he says.

At COP26, the climate conference recently held in Glasgow, UK, 22 countries signed the "Clydebank declaration" pledging to develop "green shipping corridors" between their ports, supplying the technology and expertise for ships on these routes to run entirely on green fuels. The first such corridors could be up and running by the end of the decade.

Because swapping fuels isn't exactly a quick fix, plenty of effort is also focused on reducing fuel use – and that includes returning to some of the old ways of crossing the seas. "We should be doing everything we can with wind," says Smith.

Take those strange towers that appeared on the ship back in 1925. They are known as Flettner rotors. They work using the same principle that makes a spinning baseball curve in flight: the wind moves relatively more quickly on one side of a spinning object than the other, creating a pressure difference and a resulting force. In this case, it isn't a ball but a tall, rigid pole, spun on its long axis by a motor. "They're completely bizarre-looking things, but it works," says Allwright.

Finnish company Norsepower has done about 10 Flettner rotor installations in the past decade, including on a tanker called the Maersk Pelican. An independent assessment showed that the tanker saved about 8 per cent on fuel over one year thanks to the rotors. Other studies predict the devices could make savings of closer to 20 per cent. Earlier this year, five rotors were installed on the Sea Zhoushan, a gigantic ore carrier. Other more exotic incarnations of sails are being developed too (see "Water wings", page 47).

> "If we wanted to propel a ship with just batteries, we'd have no room left for cargo"

Of course, the wind isn't always up, or blowing in the right direction. But improved weather forecasts and route-plotting software have eased those troubles, says Allwright. And other more innovative strategies could make use of the wind no matter what. The Wind Hunter project from Japanese company Mitsui O.S.K. Lines is aiming to create a tanker that would produce hydrogen from wind-made electricity while moving: the tanker could set out empty and create its own environmentally friendly cargo en route, in a win-win for low-carbon fuels. For now, though, only 15 large international ships use wind assistance of any kind, says Allwright – although he expects that to ramp up quickly.

All such efforts will be needed to hit the IMO's target of 50 per cent emissions reductions, says Smith. But that is a low bar, considering the global goal of net-zero emissions by 2050. For shipping too, he says: "It should be zero." The day might come sooner than we think when there are more ships moving silently across the waves, like that mysterious craft that set sail on the Baltic all those years ago. ▮

Nicola Jones is a science journalist based near Vancouver, Canada

GW pharmaceuticals

GW/Jazz's purpose is to innovative to transform the lives of patients and their families.

We are dedicated to developing life-changing medicines for people with serious diseases—often with limited or no therapeutic options.

Growing Operations is a multifunctional department responsible for the production of the raw materials from which me manufacture out plant-based medicines, as well as the delivery of now plant varieties and cultivation methods to support our development pipeline.

Genetic Fingerprinting Senior Scientist / Senior Molecular Plant Breeding Scientist

To lead the development and provision of genetic forensic testing methods related to the manufacture of plant-derived pharmaceuticals.

Manager, Botanical Research (Mass Spectrometry SME)

Manager/Mass Spectrometry specialist role in our Botanical Characterisation group – to lead group of research scientists, oversee all MS related projects and become Mass Spectrometry specialist for all scientific functions at KSP.

To make an application please visit: **www.gwpharm.co.uk/careers**

GRESHAM
COLLEGE

PROFESSOR OF PHYSIC

Applications are invited for the position of the Gresham Professor of Physic. Gresham College has been giving free public lectures since 1597; today these lectures are both presented in person in London and live-streamed to a global audience. Gresham Professors are outstanding in their fields and superb communicators, able to connect with an audience whose members may not have specialist expertise in the subject, but who will be informed people with a thirst for increased knowledge and understanding.

The Professorship of Physic is open to any discipline within the field of Medicine and the Biological Sciences.

The appointment is part-time from 1 August 2022 and normally for three years. Gresham Professors present a series of six one-hour lectures each academic year. They also fully participate in College life, attending the Academic Board, participating in promotion and outreach, attending social events and acting as ambassadors for the College. The post offers excellent opportunities to widen public exposure for the successful candidate. The College pays an annual stipend of £8,000 (plus reasonable expenses) and encourages applications from all backgrounds and communities.

Further information about this position is available on the Gresham website at: https://www.gresham.ac.uk/vacancies/physic

Informal discussion may take place with the Academic Registrar,
Dr M. Clare Loughlin-Chow, Gresham College, Barnard's Inn Hall, Holborn,
London EC1N 2HH.
Telephone 020 7831 0575 Email: c.loughlin-chow@gresham.ac.uk

The closing date: 9:30 am **Monday 24 January 2022.** Interviews will be in London on **Thursday 3 March 2022.**

"Facts do not cease to exist because they are ignored" Aldous Huxley
"The good thing about SCIENCE is that it's TRUE whether or not you believe in it."
"THOSE WHO CAN MAKE YOU BELIEVE ABSURDITIES CAN MAKE YOU COMMIT ATROCITIES" VOLTAIRE
T-340
Impossible Trident
redmolotov.com
0121 559 2685
LIFE
THE UNIVERSE
42
EVERYTHING
PAN GALACTIC GARGLE BLASTER
TESLA
We Do Mugs Too!
SCHRÖDINGER'S CAT IS ALIVE DEAD

Puzzles
Try our crossword, quick quiz and logic puzzle p53

***Almost* the last word**
Can bullets fired into the air injure us when coming down? p54

Tom Gauld for *New Scientist*
A cartoonist's take on the world p55

Feedback
The future, now, via planting laurels: the week in weird p56

Twisteddoodles for *New Scientist*
Picturing the lighter side of life p56

Stargazing at home

How to spot Ceres

Now is the perfect time to see the only dwarf planet in the inner solar system as it sweeps closest to Earth, says **Abigail Beall**

Abigail Beall is a feature editor at *New Scientist* and author of *The Art of Urban Astronomy* @abbybeall

What you need

Binoculars or a small telescope

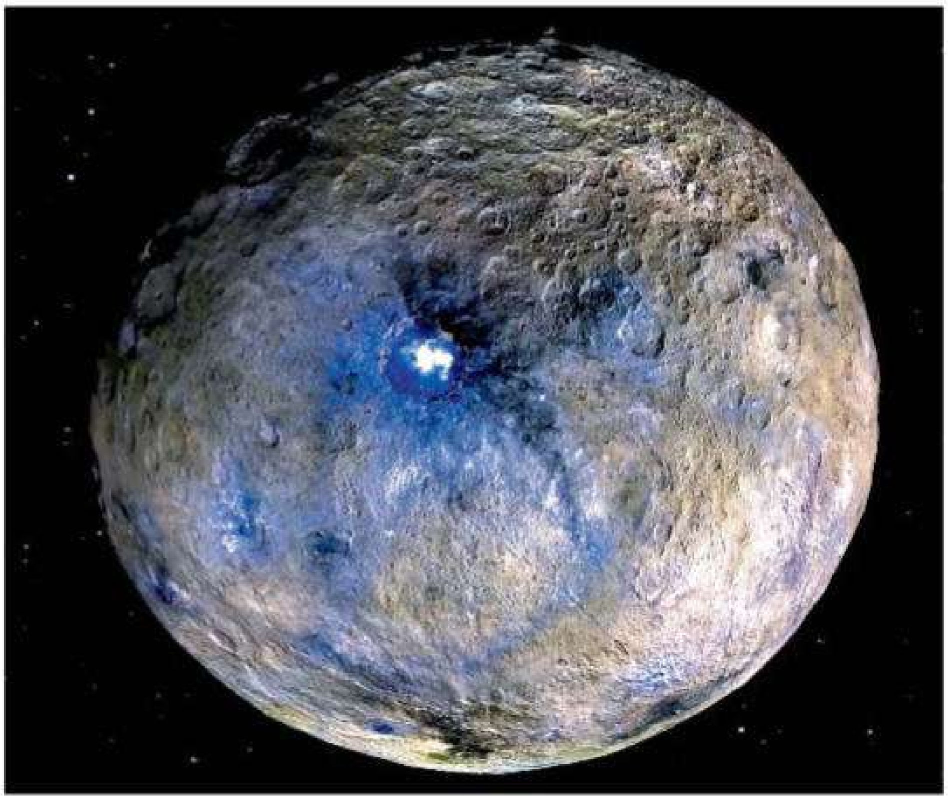
THERE are eight planets in the solar system, according to the International Astronomical Union (IAU), which changed Pluto's classification from planet to dwarf planet in 2006.

Dwarf planets orbit the sun like regular planets and are big enough to become rounded under their own gravity, but they aren't massive enough to clear their neighbourhood of other objects, while planets are.

Pluto is the most famous of the dwarf planets, but the solar system is full of objects that meet the classification: a study in 2019 found there were more than 120 of them. Officially, though, the IAU has confirmed only five dwarf planets. No matter which metric you look at, however, only one of these dwarf planets lives in the inner solar system, in the asteroid belt between Mars and Jupiter. This makes Ceres a fantastic dwarf planet to find in the night sky.

Ceres was discovered in 1801, 45 years before the discovery of Neptune and 129 years before that of Pluto. Back then, it was considered a planet. In the 1850s, Ceres was reclassified as an asteroid, then it was transferred to the dwarf planet category, along with Pluto, in 2006.

When visible, Ceres is bright enough in the night sky to be seen with a pair of binoculars or a small telescope. On 27 November, Ceres is at opposition, meaning it is the closest it comes to Earth. It will be visible all night, and it should also be possible to see it nightly until the new moon on 4 December.



NASA/JPL-CALTECH/UCLA/MPS/DLR/IDA

You will need a dark sky to find Ceres, so get yourself away from light pollution such as street or building lights, if you can. Let your eyes adjust for at least 15 minutes before trying to identify Ceres. Where it will appear will depend on the date and time, so use a stargazing planner before you start to locate where in the sky Ceres will be. If you look during the dates I am suggesting, Ceres will be in the constellation Taurus.

Find Taurus using Orion. In the northern hemisphere, follow the three stars of Orion's belt from left to right (in the southern, follow them right to left). This will guide you to the V-shaped Hyades star cluster, which contains the bright star Aldebaran. Keep your eyes moving and you will see the Pleiades star cluster, which looks like a tiny version of the Plough or the Big Dipper.

To find Ceres, identify the star Gamma Tauri, which marks the tip of the V of the Hyades cluster. Look between Gamma Tauri and the Pleiades cluster, only about the width of your thumb – or three full moons – away from Gamma Tauri. That is where Ceres will be on 27 November.

If you are unsure, use a stargazing app to identify the stars around where Ceres should be in the sky, before letting your eyes adjust and using binoculars or a telescope to find the dwarf planet. Happy hunting. ▮

Stargazing at home appears every four weeks

Next week

Science of gardening

These articles are posted each week at newscientist.com/maker

29 – 31
JANUARY
2022

New Scientist Live

Manchester and Online

New Scientist Live is going hybrid, with a live in-person event in Manchester, UK, that you can also enjoy from the comfort of your own home.

Join us for thought-provoking talks from the world's best science speakers on topics from particle physics to human health and the origins of life – a festival of bold ideas, daring innovation and transformative research available wherever you are.

Meet four of our expert speakers:

MUON PHYSICS: HAVE WE FOUND A NEW FORCE OF NATURE?
Alex Kesharazi
Research Associate, University of Manchester

ANTIBIOTICS IN CRISIS: CAN WE STEM THE SPREAD OF BACTERIAL RESISTANCE?
Kip Heath
Deputy Lead Healthcare Scientist, Great Ormond Street Hospital

THE QUEST FOR LIFE'S ORIGIN
Michael Marshall
Freelance science writer

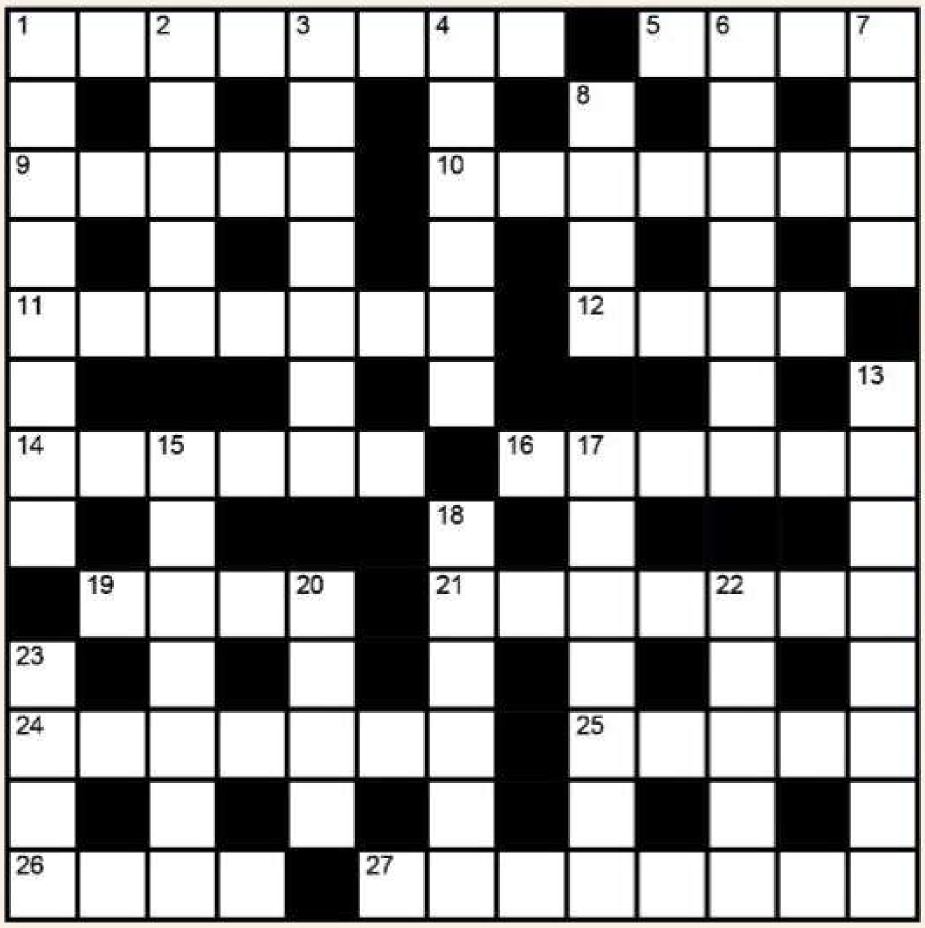
DO YOU REALLY WANT TO KNOW? THE RISKS OF PERSONAL GENETIC TESTING
Emma Yhnell
Lecturer, School of Biosciences, Cardiff University

A MIND-BLOWING FESTIVAL OF IDEAS

For the full speaker line-up and to book your ticket, visit

newscientist.com/manchester

Cryptic crossword #71 *Set by Wingding*



Scribble zone

Answers and the next quick crossword next week

One of the answers is something discovered 100 years ago. The names of four scientists who contributed to the discovery can be found in the completed grid.

ACROSS

1 Fahrenheit leaving a party in the summer (8)
5 Lawyer: I'm grateful for information (4)
9 Unattractive-sounding fruits (5)
10 Strong wind ripped a note (7)
11 Barber with beginnings of lazy eye syndrome moves unsteadily (7)
12 Without endoplasmic reticulum, figure is unable to feel (4)
14 First pair of actors in arena, competing (6)
16 Spray deer outside University College Hospital (6)
19 Lure nocturnal animal around one (4)
21 Mediterranean port starts to let agents take away Korean car (7)
24 Olive's relative stirs her teas (3,4)
25 Good toilet behind current shelter (5)
26 Favourite animal eviscerated (4)
27 Nurse extremely angry about one consequence of frostbite (8)

DOWN

1 Neighbours spread arsenic outside (8)
2 Cold food upset daughter, sadly (5)
3 Hormone makes Luis sick in pub (7)
4 Witness where cricketers may be seen? (6)
6 Can I make treatment without potassium and lacking 8? (7)
7 Eager to leave Georgia, heading north (4)
8 Smooth metal (4)
13 Terribly odd space for crabs and their kin (8)
15 Dances with son carrying two teas (3-4)
17 Banker upholding public falsehood? That's unusual (7)
18 Three Spanish articles brought up genetic variation (6)
20 Necklace discussion overheard (4)
22 Weights disturbed soil beneath Kelvin (5)
23 Post sweet stuff on second letter (4)

Our crosswords are now solvable online
newscientist.com/crosswords

Quick quiz #129

1 The maximum mass of a stable white dwarf star is named after which astrophysicist?

2 What does ARPANET, an acronym for the precursor to the internet, stand for?

3 In which part of the body would you find the ilium?

4 What does the Mohs scale measure?

5 Which hominin species was discovered in Rising Star cave in South Africa in 2013?

Answers on page 55

Puzzle

set by Alison Kiddle

#141 Sam's speed

Sam checked on his satnav and decided he could leave at 2pm for the 20-kilometre journey to the dentist. His appointment was at 2.30 (tooth hurty, boom-tish!). However, traffic that day was as sticky as the toffees his dentist had told him not to eat, and Sam spent the first 10 kilometres doing 30 kilometres per hour in a steady stream of traffic. Luckily, at the 10-kilometre mark, the road ahead miraculously cleared. What speed should Sam now maintain to arrive at his appointment on time?

Solution next week

Raining bullets

I cringe when I see soldiers celebrating by shooting their rifles into the air. What speed do the bullets return to the ground and could they hurt someone?

Anthony Woodward
Portland, Oregon, US
If you see a soldier shooting into the air, run for shelter first and cringe later. Falling bullets cause injuries and deaths.

A bullet shot straight up into the sky will fly upwards until its initial kinetic energy is exhausted. It will then start falling and accelerate towards the ground under the influence of gravity until it reaches its terminal velocity, which is limited by air resistance.

According to the US Centers for Disease Control and Prevention, falling bullets can hit the ground at speeds greater than 61 metres per second (m/s). Bullets travelling between 46 and 61 m/s penetrate skin. Faster than this, and they can penetrate the skull.

Celebratory gunfire can cause injuries that require emergency room treatment and death. In Puerto Rico, 19 people were injured by celebratory gunfire on New Year's Eve 2003, and one died. In the US too, New Year's Eve sees guns fired into the air, and deaths have occurred in the likes of Maryland, Ohio and Texas.

> **"The chance of being hit by a falling bullet is small, but if hit, the likelihood of being killed is greater than from a direct gunshot"**

Chris Daniel
Glan Conwy, Conwy, UK
Celebratory gunfire is common in many countries and sadly there are hundreds of documented cases of people being killed and injured by falling bullets.

In September this year, there was a report of 17 deaths and 41 injuries in Kabul, Afghanistan, following gunfire celebrations after the Taliban claimed to have captured the Panjshir valley.

An individual's chance of being hit by a falling bullet is small, but if hit, the likelihood of being killed is up to five times greater, at 32 per cent, than it is from a direct gunshot. This is because injury typically occurs to the head and shoulders rather than to less critical body parts.

John Crofts
Nottingham, UK
If fired vertically into the air, a bullet can reach a height of up to around 2 miles. But because of the various forces acting on a projectile that is fired in this way, the shooter is extremely unlikely to be hit by one of his own bullets as it comes back down.

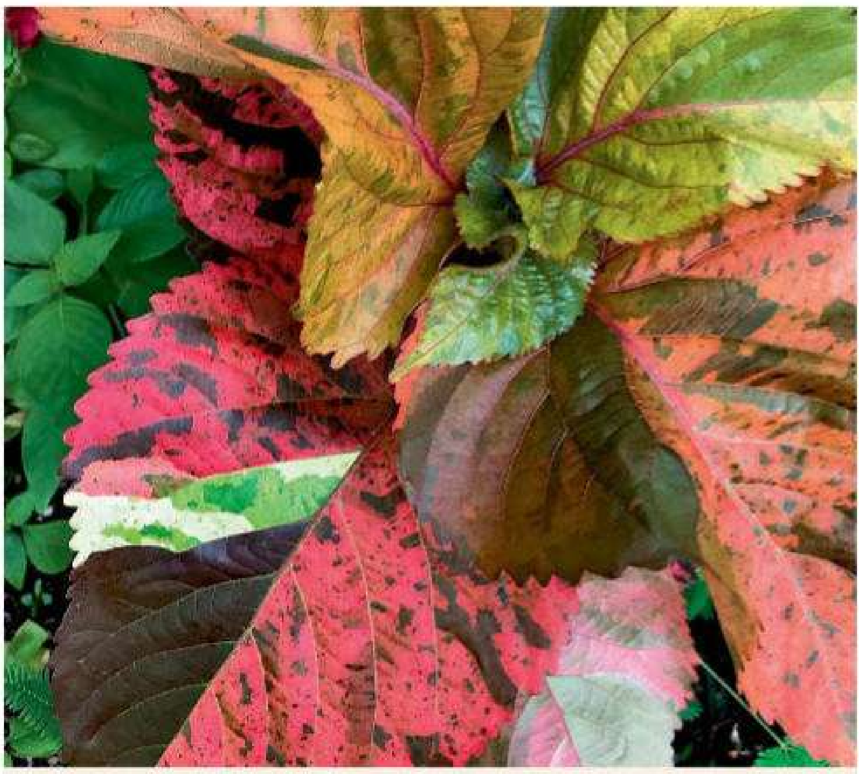
Hillary Shaw
Newport. Shropshire, UK
Even in large cities, people present a small target for a bullet falling vertically. Seen from above, the head and shoulders of a typical person who is standing has an area of around 0.1 square metres. To put this in perspective, Greater London is 1569 square kilometres and its near 10 million inhabitants present a total area of about 1 square kilometre from above. So you could fire a bullet in the air in London and (even if everybody was outdoors at the same time) it would have a 0.064 per cent chance of hitting somebody.

Mike Follows
Sutton Coldfield, West Midlands, UK
The speed of returning bullets depends partly on the angle they are fired at. Bullets fired straight upwards return with lower speeds because they tend to tumble, which increases the drag they experience. Those fired at a lower angle that follow a parabolic trajectory tend to be more aerodynamically stable. They can land several kilometres away, far enough that the sound of the weapon that fired them isn't audible, so the cause of death isn't immediately apparent.

A projectile fired upwards will still reach the ground with a good amount of kinetic energy. This may have been exploited by William the Conqueror in the Battle of Hastings in England in 1066.

The opposing army, led by King Harold, held a defensive position on higher ground and the arrows of William's Norman archers ricocheted harmlessly off their shield wall. Some scholars believe that, towards the end of the battle, William ordered his archers to fire their arrows high over the shield wall so that they rained down on the English army from above. Although these arrows, falling under the force of gravity, wouldn't have been travelling as fast as those fired directly, their energy may have been sufficient to kill soldiers who weren't expecting arrows from above.

The Bayeaux Tapestry, which depicts this battle, may possibly show Harold being struck in the eye by an arrow at a steep angle.



RIAN HUGHES

How did this leaf end up with such separate patches of different colours?

This week's new questions

Patchwork leaf **What is going on to create this amazing multicoloured leaf pattern?** ***Rian Hughes**, London, UK*

Future archive **I want to preserve scenes from my childhood (currently on DVDs) for at least the next 100 years. With technology progressing so rapidly, what is the best format for this?** ***Chris Szymonski**, Waupaca, Wisconsin, US*

Want to send us a question or answer?
Email us at lastword@newscientist.com
Questions should be about everyday science phenomena
Full terms and conditions at newscientist.com/lw-terms

Small choices

Assuming free will exists, how complex does an organism have to be to exhibit it?

Harry Lagoussis
Athens, Greece
The way I see it, the illusion of having free will (whatever that means) stems from our inability to take into account the many factors that go into our every

Tom Gauld

for New Scientist

THANKS TO A TYPO IN THE CONTRACT, THE PROFESSOR GAINED COMPLETE MASTERY OF ALL THE KNOWLEDGE IN THE HEAVENS AND THE EARTH, IN EXCHANGE FOR HIS SOUP.

thought and action. In that sense, the bare minimum that an organism would seem to need to exhibit free will is a consciousness that is complex enough to show signs of introspection, but not so complex as to be able to process all those factors.

Mike Newman
Shrewsbury, Shropshire, UK
I am intrigued that this question on free will was originally posed in the same issue of *New Scientist* as an article about sophisticated AI (9 October, p36). If the brain is indeed a super-complex computer, then free will is certainly an illusion. There is no evidence that there is anything in the brain other than synapses firing in response to stimuli.

In which case, the best we can do to assert something akin to free will might be to choose to determine an outcome based on the toss of a coin. Only by doing this can we be sure that the decision wasn't predetermined by a combination of various inputs, from education to indigestion!

> **"The bare minimum an organism would need to exhibit free will is a consciousness that is complex enough to show introspection"**

Peter Basford
Potters Bar, Hertfordshire, UK
A brain exists to receive inputs from external and internal sensors. From these, it forms a model of the world, with the organism in it, and takes decisions as to what to do based on that model.

The more sophisticated the brain, the more sophisticated the model and the more options the organism has to choose from – and the less likely it is to produce the same decision in similar circumstances.

The moth isn't capable of perceiving an option of not banging into a hot light bulb, but a fox or a human can update their models of the world to change their options and their decisions in the light of experience.

Boring number

What is the smallest whole number with no interesting properties? (continued)

Tony Sawyer
Lithgow, New South Wales, Australia
Previous replies to this question have referred to the "uninteresting number" 247. However, it doesn't seem to qualify, as 247 is the first multiple of 13 whose digits add up to 13.

Paul Whiteley
Bittaford, Devon, UK
When I was learning my times tables aged 5, I ascribed characters to numbers as a memory aid. Sixteen was always a good number, reliable and steady.

But as I grew older, 16 became more like a relative that one occasionally met at family functions: neat, handsome-ish, honest, who probably worked in a dull office job and had nothing interesting to say about anything or anyone. ▮

Answers

Quick quiz #129
Answers

1 Subrahmanyan Chandrasekhar – it is called the Chandrasekhar limit

2 Advanced Research Projects Agency Network

3 The pelvis

4 The hardness of minerals, from 1 to 10

5 *Homo naledi*

Quick crossword #96 *Answers*

ACROSS 7 Platinum, **9** Uterus, **10** Tron, **11** Intestines, **12** Aye-aye, **14** Nitrogen, **15** Goitre, **16** Distro, **19** Machines, **21** Orrery, **23** Sheet metal, **24** Mist, **25** Strike, **26** Nanotech

DOWN 1 Florey, **2** Sten, **3** Engineer, **4** Sunset, **5** Helicopter, **6** Superego, **8** Mutant, **13** Arithmetic, **15** Graphite, **17** Iron lung, **18** Isatin, **20** Number, **22** Resect, **24** Moth

#140 Drum roll
Solution

Mr Hasty is half right. At any instant in time, the contact point of the drum with the ground is stationary, with the drum rotating about this point. The top of the drum, which is in contact with the plank, therefore moves at twice the speed of the centre, or axis, of the drum. So, for every metre Mr Bodger walks towards the drum, it advances half a metre. To reach the edge of the drum, which is initially 4.5 metres away, he must therefore walk 9 metres.

The future, now

Are you the sort of person who looks at the word "challenge" and sees "change"? We are, but then we are also the sort of person that sees the words "henge" and "leech".

This probably means we aren't the sort who will be duly inspired by "Leading with Purpose – The University of Alberta Brand Story", a video introducing that institution's new "One University" brand strategy. Having had it served up to us by a mole underneath its lawns, we find ourselves overcome with increasing waves of emotion.

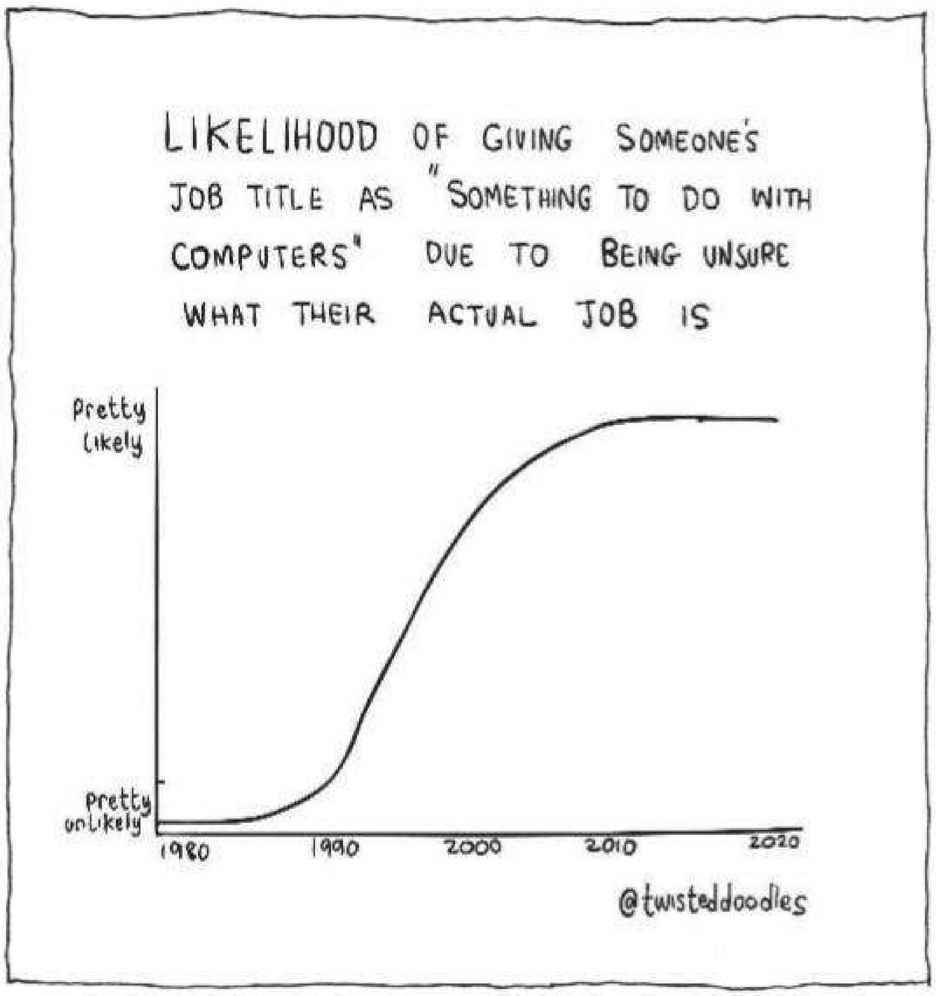
"Leading with purpose means we never rest on our laurels," we learn, to the backing of soaring synthesiser chords. "We plant them and create innovative solutions that give them room to grow."

This is a lovely picture, and provides an original perspective on the question "Where will you be when the future shows up?": inside a mature laurel hedge, surveying a blooming innovation landscape.

For those inclined to carp that the future never does show up, because that's the future's point – well, such hidebound thinking belongs in the past. "Every day, we set out to challenge the very notion of time by solving problems that don't exist yet," we are informed.

This is, our mole remarks, at least a leap forward on the standard management practice of creating problems that didn't exist and then trying to solve them. On reflection, there is a certain fresh-eyed PR person's logic in solving not-yet-existent problems: if we spend too much time solving the problems of the present, those of the future might never exist, which would invalidate the whole approach.

Twisteddoodles *for New Scientist*


LIKELIHOOD OF GIVING SOMEONE'S JOB TITLE AS "SOMETHING TO DO WITH COMPUTERS" DUE TO BEING UNSURE WHAT THEIR ACTUAL JOB IS
Pretty Likely
Pretty unlikely
1980
1990
2000
2010
2020
@twisteddoodles

Got a story for Feedback?

Send it to feedback@newscientist.com or New Scientist, Northcliffe House, 2 Derry Street, London W8 5TT

Consideration of items sent in the post will be delayed

Light in a dark place

Mind you, the laser's inventor Theodore Maiman did once describe it as a "solution seeking a problem". The expression comes forcefully to mind with a product listing Mick Dalton fishes from the bowels of the Amazon website. Describing itself as a "16-Color LED Bathroom Toilet Bowl Light", it comes equipped with a fixed colour or carousel mode and a 5-stage dimmer for selecting how brightly your toilet bowl should glow in the dark.

What particularly attracts Mick's attention is that it comes with a "motion detection sensor". We, too, are left wondering precisely how that is meant. But at least now we have another plausible answer for where we will be when the future shows up.

Never too old

Our only motions now are swiftly onwards. In answer to our recent item on how old the internet thinks people can be (30 October), Benjamin Griffiths writes that he was surprised to be turned down as a volunteer for the St John Ambulance vaccination service last year because he was too old. It turned out they had his birth year down as 1909. Benjamin assures us he isn't 111 or 112, but we are unsure whether the internet was at fault or the more traditional "dodgy handwriting". Whether institutions should be turning down the services of such sprightly volunteers is another matter.

Makes you maudlin

We recently described research that involved asking people to drink wine in a Lisbon bar and recording the effects, from decreased body awareness to increased insightfulness and originality of thoughts, as "science that just makes the world a better place" (2 October). We are more conflicted with a relatively new arrival in the journal *Personality and Social Psychology Bulletin* entitled "Mixing Misery and Gin: The Effect of Alcohol Administration on Ostracism Response".

As Twitter user Ethan Mollick's summary of the study puts it: "Someone finally tested whether drinking will make you feel less rejected in an awesome design where the treatment conditions included ostracizing random subjects & then quickly giving them 5 shots of 80 proof liquor."

The headline finding is that if you are made to feel bad about yourself, alcohol won't make you feel better. The insights "have important implications for ostracism theory and speak to boundary conditions for alcohol's ability to relieve stress", the researchers write. We note that the lead researcher of the study is from the University of Illinois at Urbana-Champaign, which, homophonically at least, suggests a certain expertise.

Pressing your buttons

"Music is the best medium for expressing emotions and arousal nonverbally," we read, possibly non-controversially, in the abstract of a 2020 paper from *Paladyn, Journal of Behavioral Robotics* forwarded to us by a colleague muttering something about coming across it "while writing an article about physiological synchrony".

Having failed to clock the title – "PLAY ME: interactive sonification of sexual arousal in long-distance relationships" – we have only just finished mopping the cocoa from the stationery cupboard floor. It is eye-opening what you can do when you use acoustic signals generated by probes inserted in and around delicate parts of the human anatomy firstly to drive a vibrating body suit worn by someone else somewhere else, and secondly to produce a musical backing track to the whole affair.

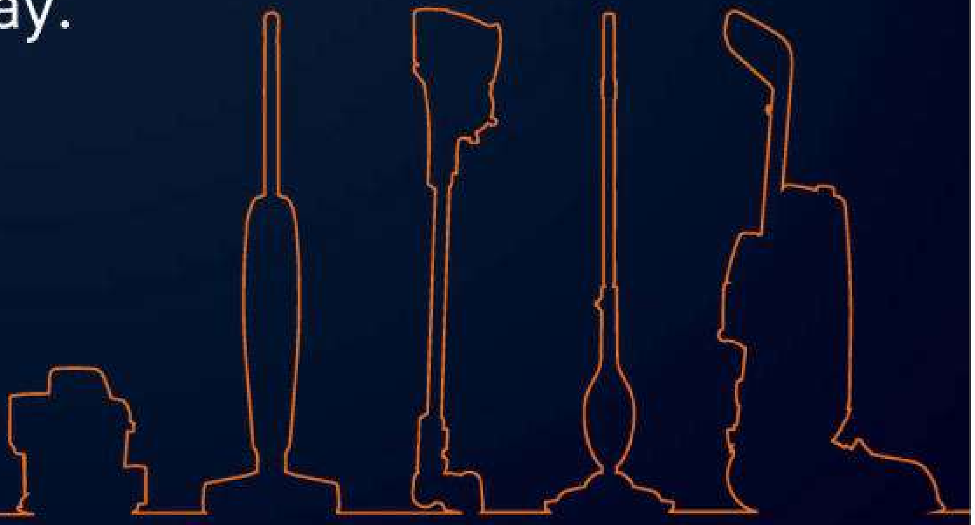
There's your answer as to whether entanglement can be achieved between classical objects, anyway. Don't ask what that sound is, it's the future arriving. ▮

vax®

BLACK
FRIDAY
DEALS

SAVE UP TO £110

Exclusive deals across the Vax range this Black Friday.



Save £110 on the VAX Blade 4 Dual Pet

Get up to 90 minutes runtime* with the VAX Blade 4 Dual Pet; designed for tougher cleaner in busier homes, it comes with an additional motorised pet tool and antimicrobial protection.

Free Toolkit + Free Delivery

Order now for £219.99
Was ~~£329.99~~

See more Black Friday deals & current offers at vax.co.uk

*Tested in standard power mode on hard floor, with floor brush switched off. Orders before 5pm Monday-Friday will be next day delivery. Outside of these times, orders will be despatched next working day. Offer only while stocks last.

VAXUK1798BI

vax.co.uk 0800 031 4970

PAYMENT OPTIONS AVAILABLE

PERSONALISE YOUR BOTTLE WITH BESPOKE ENGRAVING AT MALTS.COM

for the facts **drinkaware.co.uk**